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Everett H. Williams, Jr.
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American Eugenics Society, Inc.

ACTA GENETICAE MEDICAE ET GEMELLOLOGIAE

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First published in 1952, this Journal appears every 4 months. The Editorial Board, as well as the list of contributors, include most of the best-known names in the field of twin-research, genetics, anthropology and related topics.

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Contents

Perspectives: The First International Congress of Human Genetics, HELEN G. HAMMONS 195–200

The Estimation of Spontaneous and Radiation-Induced Mutation Rates in Man, JAMES F. CROW 201–208

The Path Between Genes and Behavioral Characters, JOHN L. FULLER 209–212

Associations Between Weight Discrimination and Hand Prints, DAVID C. RIFE 213–218

Illegitimacy in Florida, EVERETT H. WILLIAMS, JR., ROBERT M. THORNER, WINSTON EHRMANN 219–227

Book Reviews

"Trends and Differentials in Mortality" (Milbank Memorial Fund) SAM SHAPIRO 228–230

"World Population and Resources" (PEP) PHILIP M. HAUSER 230–231

"Life Tables from Limited Data" (Stolnitz) ARTHUR A. CAMPBELL 232–233

"Elements of Genetics" (Colin) GORDON ALLEN, M.D. 233–234

"Sociology and the Field of Mental Health" (Clausen), K. Z. ALTSHULER, M.D. 234–235

"Races and People" (Boyd and Asimov), RICHARD H. POST 235

"Genetics in the Atomic Age" (Auerback) RICHARD H. POST 235–236

"Education for Marriage" (Peterson) GLORIA COUNT 236–237

Periodical Abstracts

Genetics, GORDON ALLEN, M.D. 238–239

Population, GEORGE F. MAIR 239–241

News Notes 242

Membership List, American Eugenics Society, 1956 243–252

Index, Eugenics Quarterly, Volume III, 1956 253–255

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CONTENTS

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COMMENT

PERSPECTIVES: The First International Congress of Human Genetics

The tremendous range of the still young science of human genetics was vividly demonstrated by the First International Congress of Human Genetics in Copenhagen during the first week in August of this year.

Topics ranged from very specialized subjects such as hereditary optic atrophy and defects in tooth enamel and dentin to the broad problems of the effect of radiation on human populations and the place of human genetics in medicine.

The Congress effectively illustrated not only the importance of highly specialized studies but also the necessity for evaluating the implications of genetic findings. It indicated the very great distance which the study of man's heredity has to travel before it can have very much to say about such fundamental questions as the role of heredity in normal characteristics like intelligence and personality and in widespread diseases like cancer and heart ailments; but at the same time it highlighted the advances in human genetics since World War II. Human genetics was seen as in no sense an isolated discipline but one which cuts across many fields: medicine, chemistry, biology, sociology, psychology, anthropology, eugenics, and so on. The presence of a large number of medical men—as much as one-fourth of the registrants—attested to the increasing role that human genetics is playing in medicine.

News interest was highest in the reports on the genetic effects of radiation and mutation in man. The Congress went on record as acknowledging the genetic danger of radiation for mankind. The following resolution was unanimously passed.

> "The damage produced by ionizing radiation on the hereditary material is real and should be taken seriously into consideration in both the peaceful and military uses of nuclear energy as well as in all medical, commercial and industrial practices in which X-rays or other ionizing radiation is emitted. It is recommended that the investigation of the amount and type of damage and of related genetic questions be greatly extended and intensified with a view to safeguarding the well-being of future generations." (August 6, 1956)

This resolution was a response to a request by Dr. Eve of WHO for an expression of the viewpoint of congress members on this subject.

A report was made by James V. Neel and William J. Schull of the United States on the Atomic Bomb Casualty Commission's (ABCC) study of possible delayed biological effects of exposure to atomic bombing at Hiroshima and Nagasaki.

There is no really clear indication that the radiation history of the parents, one or both of whom were exposed to the effects of atomic bombing, affected characteristics of their children during the first year of life, according to Dr. Neel.

However, "smallness" of radiation effects was expected and overshadowing "largeness" of other sources of variation, he stated.

Possible observable effects of irradiation upon the first generation born after an atomic bombing are many and varied, including changes in sex ratio, frequency of stillbirths and congenital malformations, and infant mortality. But each of these indicators of genetic damage is also influenced by a number of other factors.

In association with the Japanese postwar rationing system for pregnant women, data were obtained by the Commission between 1946 and 1953 for 93 per cent of the births in Hiroshima and even more in Nagasaki.

The basic question, Dr. Neel declared, was: Is there a difference between outcome of pregnancy in irradiated and non-irradiated parents? Statistical adjustment was made for consanguinity, maternal age, and parity because they seemed to introduce potential bias of some magnitude.

However, most of the analyses failed to reveal a significant relationship between indicators of genetic damage and parental radiation history.

We are left in an unsatisfactory situation in respect to firm conclusions concerning radiation-induced genetic changes in human populations, concluded Dr. Neel.

Further studies bearing on the load of mutations in man were discussed by H. J. Muller of the United States.

Recent evidence from man and further studies on animals bear out the estimate of 0.1 as the minimum spontaneous mutation rate in man, according to Dr. Muller. (This means one newly mutated gene in every ten gametes—sperms and eggs—or one in every five persons.)

Growing doubts about the discreteness or indivisibility of the gene do not affect this conclusion. Support is also increasing for the belief that in man most detrimental "recessive" traits damage chiefly heterozygous carriers where about one-twentieth of their full effect may be expressed. Most mutations can therefore be regarded as detrimental dominants, and their effect, according to the above estimate, is to eliminate one person in five before reproduction or to depress average fitness by one-fifth, Dr. Muller concluded.

Using consanguinity data, Morton, Crow and Muller have reached similar estimates. Among offspring of first-cousin marriages, one-sixteenth of detrimental recessives should find full expression. If this is assumed to be on the average 20 times as great as heterozygous expression, the extra handicap of such offspring represents about 20 times 1/16 the impairment carried in one gamete. An excess mortality of 6 per cent has been reported for the first 20 years of life in children of cousins, and the total impairment is probably twice this, or 0.12. When 0.12 is divided by 20/16, the result is just about 0.1, in agreement with the estimated mutation rate.

Dr. Muller pointed out that further consanguinity studies should throw light on such questions as the following:

1. The extent to which differences in mortality, infecundity, etc., are in general genetic, that is, selectable.

2. The extent to which our modern civilization is decreasing genetic elimination below the equilibrium level, evidenced by differences in mortality, infecundity, etc., resulting from inbreeding, between populations subjected to different present standards of living and medical care. Here it is imperative that data be obtained from populations still living under primitive conditions of selection before it is too late.

3. The increase in mutation rate that a population under given conditions of living can tolerate without serious deterioration.

In this connection Dr. Muller noted that knowledge of the total spontaneous mutation rate and load is an invaluable means of assessing the total effect produced by a given amount of radiation or other mutagenic agent (if the index of a mutagen's effectiveness has been obtained by data on mutations at specific loci or of some otherwise specified category).

The first task facing human geneticists is to obtain detailed knowledge of the genetic mechanism underlying illnesses so that estimates of the dysgenic effect of a mutation rate increase can be made, said T. C. Carter of Great Britain.

The outcome of calculations of the long-term genetic hazard to man from ionizing radiation depends upon the assumptions about the underlying genetic mechanism. Most calculations have assumed that all mutant alleles are unconditionally detrimental and must be eliminated by natural selection, but this may be invalid under certain circumstances, according to Dr. Carter.

The inheritance of the blood groups forms one of the most precise areas of our genetic knowledge. This section of the Congress demonstrated that discovery of the mode of inheritance of a very specialized characteristic such as blood groups can form the foundation for further discoveries with the broadest implications, going far beyond the limited nature of the original findings. Some very significant directions for genetic research were indicated here.

The rich potential of the blood groups for the whole area of health and disease was revealed in a report by J. A. Fraser Roberts of England on associations between blood groups and disease.

Persons of blood group A have a much greater risk of cancer of the stomach than those of the other groups. Duodenal ulcer and, to a lesser extent, gastric ulcer are commoner in people in group O. Group B so far appears to be favored.

The solid work of many people on the blood groups forms the basis of this report, stated Dr. Fraser Roberts. The crux of the whole problem is numbers. To detect associations, series are needed amounting to thousands rather than hundreds, and a really large number for a single disease —over 3,000—was collected only three years ago.

The incidence of cancer of the stomach at 10 centers is 1.23 times as great in persons of group A compared with other groups.

The incidence of duodenal ulcer in group O individuals is 140 as against 100 in persons of A, B, and AB. Here data were collected from 7,000 cases in 8 centers. All the areas studied from Oslo to Iowa show increased incidence, Dr. Fraser Roberts said, but highly significant heterogeneity was noted very recently in the Glasgow area in the largest sample so far from a single center where the relative incidence was down to 1.17. An immediate explanation for this low figure is not apparent, but when more series are collected, perhaps heterogeneity should be expected.

At the same 8 centers, the relative incidence of gastric ulcer in persons of group O is 1.23 times that in persons belonging to the other groups.

There is also quite good evidence that diabetes is commoner in those of blood group A, but many more figures are needed here, Dr. Fraser Roberts believes. Another study also shows association between group A and pernicious anemia.

There is overwhelming evidence for association between the blood groups and three diseases, cancer of the stomach, duodenal ulcer, and gastric ulcer, and quite strong evidence for diabetes mellitus and pernicious anemia, Dr. Fraser Roberts concluded. In two of these diseases persons of group O are at a disadvantage, in three, persons of group A. In all five diseases persons of blood group B are favored. There is no satisfactory evidence for associations between Rhesus and disease, other than hemolytic disease of the newborn, in his opinion.

Everything favors a rapid increase of knowledge in this field, Dr. Fraser Roberts predicted.

New horizons for research on the heredity of "normal" characteristics, so badly neglected thus far and of such great interest to eugenics, were opened up by several papers.

There are enormous individual differ-

ences in people which must be in large part genetically determined, declared Roger J. Williams of the United States in a discussion of the human implications of biochemical genetics. But investigations of the metabolism of normal people are still in their infancy.

People vary greatly, said Dr. Williams, as to enzymatic efficiency, distinctive excretion patterns, etc. There are big differences in the amounts of pepsin in our digestive juices, taste responses, blood composition and reaction to drugs. Some people can drink ten times as much alcohol as others, Dr. Williams pointed out, and reactions to such drugs as morphine vary widely.

We are certain that genetic factors are involved in many of these things and that there are real biochemical differences, Dr. Williams declared. Here we have a key to understanding disease, he believes. Some diseases, for example, may actually be caused by a high nutritional demand. Because of distinctive metabolic patterns in people, there are corresponding distinctive patterns of nutritional needs among "normal" individuals. These call for extensive research.

Scholars in all fields need to divest themselves both of environmentalism and hereditarianism, Dr. Williams stated, and adopt the only view that will stand up biologically: that of a "genocotarian," who fully recognizes the interplay of genic and ecologic factors. Expertness must be developed in adjusting the environment (including nutrition) to meet the genetically determined needs of people. And here human geneticists must be involved, Dr. Williams feels. In the field of the social sciences little consideration is given to genetic differences and human problems. Adoption of the genocotarian viewpoint will lead to recognition that human genetics as a discipline is far more important than most geneticists have realized.

The implications of human biochemical genetics are extremely broad, Dr. Williams concluded, and encompass such diverse topics as dental caries, obesity, alcoholism, mental disease, juvenile delinquency, divorce, race relations, and certainly politics and philosophy.

New directions for study of human behavior and growth were outlined by L. W. Sontag of the United States, reporting in collaboration with S. M. Garn on the Fels Research Institute studies of 200 families.

The autonomic nervous system and its behavior during stress offer a very fruitful approach to the genetics of behavior, Dr. Sontag indicated. The pattern of autonomic response is characteristic of the individual and fixed over a fairly long period of time. Here is an indication that many psychosomatic diseases stem not just from a particular kind of stress or parent-child relationship but from an inherent and (presumably) gene-determined tendency to over-react in one branch or another of the autonomic nervous system. The tendency for particular disordres (ulcers, hypertension, anxiety neurosis) to recur in families, Dr. Sontag suggested, may be due to this underlying pattern of autonomic response.

There is also much evidence concerning the genic control of growth, according to the Fels studies. A new marker gene, a characteristic of the skeleton, has been located which appears to be fairly common.

Experiments in behavioral genetics in animals also indicate that genetic effects upon behavior are widespread rather than exceptional, reported J. L. Fuller of the United States for the Jackson Memorial Laboratory. The organic basis of genetic effects upon behavior has in different instances been related to quantitative variation in enzyme activity in the brain, relative rates of recruitment and inhibition of neural circuits, somatic response to steriod hormones, and integrative functions in local brain areas.

Studies in the heredity of some of the commoner diseases such as cancer, hypertension, arthritis, and diabetes were pre-

sented in various sections of the Congress. This material of course is of great immediate interest, unlike some of the studies on rare conditions. Dr. Fraser Roberts reported that the following hypothesis on hypertension has been strengthened by reexamination of figures based on work done by Miall, Oldham, Pickering, Sowry, and Hamilton:

> The genetic element in hypertension is no more than the tendency for relatives to resemble each other in patterns of arterial pressure, a tendency which is quantitatively the same at all levels from highest to lowest. Essential hypertension is no more than the positive end of the normal.

Research was reported on uterine cancer, childhood cancer, and cancer among twins in Denmark. Papers were given on diabetes mellitus in women and on the children of young diabetic mothers. The heredity of arthritis and rheumatic diseases was discussed as was muscular dystrophy.

A new theory of inheritance was proposed for a rare disorder, alcaptonuria, which is apparently the only known hereditary disorder which practically always leads to arthritis. Robert A. Milch and Henry Milch of the United States suggested that the disease is not genetically determined by a single recessive autosomal recessive gene. It may be determined by an incompletely penetrant dominant gene that coexists with at least one other pair of modifying gene factors.

A number of twin studies were reported in various sections. These isolated studies point up the desirability of larger and more coordinated twin research.

Several papers on various aspects of consanguinity were presented. In a study of isolates Jean Sutter and Léon Tabah of France pointed out that consanguineous marriages have been decreasing for some time in all French districts because the trend of population segments is to fuse more and more with each other.

Dr. Sutter proposed a new approach for studying isolates which would take into account the changing cultural and social milieu. He stated that theoretically (Sewall Wright) it is now possible to study the evolution of an isolate by measuring the distance that separates the birthplace of the children from the place the parents originated. Unfortunately the administrative documents cannot furnish any useful data for this purpose. When research is done on a large scale, one can only make use of the distance between the places of residence of the spouses, these data being easy to obtain. Analysis of variance of this distance in the course of time should provide highly useful information on the transformation of isolates.

His own studies of isolates have shown that their boundary lines today tend to fan out with the result that as an isolate grows in size second-cousin marriages among its members becomes less and less frequent.

First-cousin marriages have been the accepted test of the degree of consanguinity within a given isolate, but with the proposed new method ethnic groups can be studied on the basis of consanguinity as conditioned by location.

In another study of isolates a high prevalence of genetically determined disease was indicated. This was reported by C. J. Witkop of the United States from a preliminary study of 26 tri-racial isolates in the eastern United States, which are mixtures of Caucasian, Negro, and American Indian races. One of these groups being studied by the National Institutes of Health has in-married for nearly 400 years. These groups were first isolated from the rest of the community on a racial basis, but they are now isolated on a genetic basis as members of the community have stated they would not marry into these groups because of their numerous genetic defects.

About 18 per cent of the institutional inmates produced by first-cousin marriages seem to have the mental endowment of their parents in a study reported by Carl A. Larson of Sweden on kin matings be-

tween parents of mental defectives born and institutionalized in a Swedish region of about 3.4 million population. In this respect these inmates agreed with probands of unrelated parentage, declared Dr. Larson. Thus the observation of mental deficiency in children of first cousins permits no immediate conclusions about the mode of inheritance.

Total genetic morbid risk for the children of first-cousin marriages was considerably increased—about 16 per cent against about 4 per cent for the control children—in a study of 34 cousin marriages in a north Swedish geographical isolate, according to a report by Jan A. Böök of Sweden. Dr. Böök warned, however, that these results refer to a specific population and should not be generalized uncritically.

The present view that the number of chromosomes in normal human cells is 48 was challenged by a report in the cytology and radiation section by C. E. Ford and J. C. Hamerton of England (supplementing Tijo's and Levan's recent work).

"The chromosome number of man is $2n = 46$, not $2n = 48$ as generally believed," they declared.

In this same section it was stated that it is now possible to detect some sex-linked hereditary diseases at a state of pregnancy where interruption is still possible. This material was presented by F. Fuchs, E. Freiesleben, E. E. Knudsen, and P. Riis of Denmark.

In all some 200 papers were presented at the Congress, and it has been possible here to mention only a fraction of them. The sectional meetings covered the following: internal medicine; psychiatry, mental deficiency and psychology; population genetics, anthropology, and blood groups; neurology; cytology and radiation genetics; ophthalmology; genetical and statistical analysis. The proceedings are to be published in the near future by the Congress.

Broad in scope as the Congress was, however, the lack of emphasis upon population was deplored by Dr. Sutter of France in the closing session. He recalled that at the World Population Conference in Rome in 1954 emphasis was placed upon human genetics. He felt that a human genetics congress likewise should emphasize population problems.

The First International Congress of Human Genetics formed a real meeting ground for the exchange of information and opinion. National committees sponsoring the Congress represented fourteen countries, and delegates from thirteen other countries participated. Nearly six hundred people were registered either as full members or associates. The American Eugenics Society was one of the sponsors of the Congress from the United States.

At the close of the Congress the members paid tribute to the chairman, Tage Kemp of Denmark, to the Danish Organizing Committee, and to the people of Copenhagen for the exceptionally effective organizational work and unusual hospitality. A committee was set up to consider proposals for a second congress.

HELEN G. HAMMONS
American Eugenics Society

THE ESTIMATION OF SPONTANEOUS AND RADIATION-INDUCED MUTATION RATES IN MAN*

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This is the second article in a series on Genetics and Radiation.

NEITHER THE METHODS USED nor the results obtained in human mutation studies would be regarded as acceptable in experimental animals and plants. Yet there are decisions of public policy that cannot wait for better knowledge, so it is necessary to make the best possible estimates from available information. At the same time we must remain aware of the limited accuracy and provisional nature of such estimates.

As long as we deal with spontaneous mutation leading to specific hereditary conditions there is information from direct human studies. But if any attempt is made to measure the overall mutation rate it is necessary to use experimental animals for part of the information, and this introduces all the uncertainty of extrapolating from one organism to another. In assessing radiation effects the situation is still worse, for almost all the information has to come from experimental animals. Such human data as there are permit only the broadest of limits.

This article is an attempt to present such estimates as can now be made for human mutation rates and for the amount of increase to be expected from a given amount of radiation. In a later article some possible eugenic and evolutionary consequences of an increased mutation rate will be examined. I am relying largely on published research and shall cite various recent summaries that give more details than are possible here, but I should like to call special attention at the outset to two recent reports sponsored by the British Medical Research Council and the National Academy of Sciences of the United States (1, 2). These two studies approach the problem of radiation damage from quite different directions, yet reach remarkably similar conclusions and recommendations.

*Paper No. 642 from the Department of Genetics, University of Wisconsin. Dr. Crow was a member of the Committee on Genetic Effects of Atomic Radiation of the National Academy of Sciences.

Spontaneous Rates: Dominant Mutants

In principle, the measurement of the rate of occurrence of dominant mutations offers no difficulty. With regular dominant inheritance every affected individual has at least one affected parent, and any exception to this rule may be regarded as of mutational origin. Given adequate census data, the investigator simply records the proportion of births where affected children are born of normal parents. The mutation rate *per gene* is half this proportion, since either of two genes may have mutated, that carried by the sperm or that in the egg.

Several investigators have measured mutation rates this way. A recent summary is given by Penrose (1, appendix C). He lists six conditions (epiloia, achondroplasia, aniridia, microphthalmos, retinoblastoma, and dominant partial albinism). The mutation rates all lie between 4 and 45 per million genes per generation, with an average of roughly 15 per million.

Despite its seeming directness and free-

dom from gratuitous assumptions, this procedure has several sources of bias. One possible error is a mistake in ascertaining the true parentage of the mutant child. For this reason the best data are for genes that cause a conspicuous abnormality or a reduction of fertility, where such a mistake is much less likely. Note that the conditions listed above are of this type.

Another source of error is that the mutant trait may be mimicked by a non-hereditary condition (*i.e.*, is a "phenocopy"), or that the mutant gene is not always expressed (*i.e.*, is not fully penetrant).

A third possible error lies in the fact that any of several genes may mutate to give essentially the same abnormality. In animal studies experiments are designed so that similar appearing mutants at different gene loci can be distinguished, but in man this is hardly ever possible. Thus the investigator may not be measuring the mutation rate of a single gene, but the total rate of all genes producing a similar abnormality.

For all these reasons the published mutation rates are probably over-estimates of the true rates. This is even more true if these rates are to be regarded as representative of mutation rates in general. For a mutant with a high rate of occurrence, being more common, is more likely to be known to geneticists and more likely to be included in a mutation rate study.

There are sources of bias in the opposite direction also, but probably of less consequence. One possibility is that some of the mutant individuals, being weak, die as embryos and are not counted.

Finally, the number of actual mutant individuals in these studies is not large, so the estimates are subject to the caprices of small sample numbers.

We can bolster our confidence in these figures somewhat by estimating them another way. A second, more indirect procedure depends on knowledge of the relative "fitness" (*i.e.*, ability to survive and reproduce) of persons with the mutant gene. For example, achondroplastic dwarfs, because of lowered viability and fertility, are represented next generation by only about 1/5 as many descendants as a normal person. Therefore, of the achondroplastics in the population, approximately 1/5 will have inherited the condition while the other 4/5 will be from new mutations. Using this information one can obtain the mutation rate from the frequency of the abnormality in the population. The procedure is explained more fully in (1).

The mutation rates given above have been checked by this indirect method with general agreement. Unfortunately most of the sources of error in the direct method that cause overestimation of the true rate also apply to the indirect. We shall take the average above, 15 mutations per million genes per generation, as an estimate, but with the realization that it is more likely to be too high than too low.

Spontaneous Rates: Recessive Mutants

Recessive mutants are much more common than dominants in experimental animals. But the measurement of mutation rates to recessives is complicated by the fact that the mutant must be in the homozygous state to be detected, and the actual mutation may have occurred many generations earlier. There are special techniques in experimental animals that circumvent this difficulty, but they are not available for man.

However, there is one class of recessive mutants that can be effectively studied in man, those that are on the X-chromosome (sex-linked), for here a mutant is expressed on the average every three generations. This is because the male has only one X-chromosome while the female has two; therefore 1/3 of the mutant genes are in males where their effect is fully expressed and detectable.

The mutation rate to sex-linked recessives may thus be measured by indirect methods analogous to those used for ordinary, non sex-linked dominants. The method assumes that the fitness of the

mutant type has been constant for the past dozen generations or so, which is dubious for most genes. But it is reasonable for genes that are highly incapacitating, and which in the past must have resulted in almost certain failure to reproduce. Two sex-linked mutants that have been studied approach this condition, hemophilia and sex-linked muscular dystrophy. The average of several studies on each give respective mutation rates of about 25 and 60 per million genes per generation (1).

The measurement of autosomal recessives is a highly dubious undertaking. A number of unrealistic assumptions must be made, so one can have little confidence in the results.

The measurement is strongly influenced by even small heterozygous effects and by the amount of inbreeding, neither of which can be assessed for times in the remote past. Therefore, although such estimates have been made (see 1, appendix C, for summary), I shall not include them here.

Estimating the Overall Mutation Rate

We should like to be able to measure the total mutation rate of all genes, for then we should be in a position to make a reasonable assessment of the total mutational damage. But this is clearly impossible, for not all mutations have detectable effects. A direct procedure might be to use the singlé gene rates discussed in the previous section and multiply by the number of genes. But we don't know the number of genes in any organism, much less in man. A more realistic approach to the problem is to measure the rate of mutation to a broad but clearly definable class of mutants. Mutations that cause death (lethals) or that measurably decrease the viability (detrimentals) constitute such a class.

I shall describe two procedures that give estimates for the total frequency of a class of mutations. The first has been used by Muller (3) and consists of multiplying the single gene rate in man by a factor, obtained from Drosophila data, relating the single gene rate to the overall rate of lethal and detrimental mutations.

In Drosophila it is possible, by using methods that also owe their origin to Muller, to measure the total rate of occurrence of sex-linked lethal mutations with great precision. Mutations causing a detectable decrease in viability are about four times as frequent as lethals, so we multiply the lethal number by 4 to include detrimentals. Then we note that the X-chromosome in Drosophila has about 1/6 of all the mutations in a sperm or egg, so we multiply by 6. The value finally obtained is about 10,000 times the mutation rate for a representative single gene (3).

I shall note three points about this ratio. First the figure is for radiation-induced, not spontaneous mutations. This is necessary since the latter occur in too low frequency to provide reliable estimates. However there is no reason to think the ratio would be different. Second, the sensitivity of the method is such that a detrimental mutant is detected only if it reduces the survival by about 10 per cent or more; lesser mutants go undiscovered. Finally, the survival being measured is in the egg, larva, pupa, and perhaps early adult stages; a mutant that decreases the life expectancy of adult flies or lowers their fertility is not counted by this procedure.

I shall take the value given above as the average of the dominant mutation rates, 15 per million genes, as representative of single locus rates in man. Multiplying this by 10,000 we obtain .15; that is, 15 sperms or eggs in a hundred may be expected to carry a new lethal or viability-reducing mutation.

There is of course a large error possible in this, because all of the factors that were multiplied together are individually subject to error. But more important we are assuming that man is like Drosophila in two important respects. We are assuming first that the ratio of overall to single locus mutation rates is the same in Drosophila

and man. This is equivalent to assuming that the number of genes is the same. If man has more than Drosophila, we have produced an underestimate. But perhaps this compensates for our probable overestimation of the single locus rates. Secondly, we are assuming that the class of mutants that increase the probability of death between the egg and adult stage of Drosophila corresponds in a meaningful way to some class in man. It is probable that some of these, perhaps a large fraction, correspond to very early embryonic deaths in man that are of relatively little consequence.

These are serious limitations, but the procedure does give a concrete estimate. It is convenient to think in terms of a population of 100 million persons, very roughly the number of children that the present population of the United States may be expected to produce. In these terms the total number of estimated new mutations (of the designated class) would be $.15 \times 100$ million $\times 2$, or 30 million. The factor of 2 comes from the fact that each person has two sets of genes, one from the sperm and one from the egg.

Fortunately an entirely different method is available. This also combines information from man and from Drosophila, but uses entirely different information from both than the above method does, so it provides an independent estimate (4).

This method makes use of the fact that in children whose parents were related a certain fraction of the genes are made homozygous, and therefore the recessives can be expressed. Genetic theory tells what this fraction is for any degree of relationship. Using this, we can estimate from the increased death rate in children from consanguineous marriages how much lethality is carried in the form of hidden recessive genes. Morton, Muller, and I (4) have examined death rate data from consanguineous marriages and have concluded that the average person carries the equivalent of about four genes that, if made homozygous, would cause death. That is, there are 4 lethals, or 8 mutants with 50 per cent probability of causing death, or 40 with 10 per cent probability, or some other equivalent. The deaths on which the calculations were based occurred between birth and young adulthood (including stillbirths), so the class of mutation studied is that causing death in these ages.

The four hidden lethal equivalents per person are due to mutations that have occurred some time in the past and which still persist in the population. To estimate the rate of occurrence of mutations it is necessary to know how long the average mutant persists. The major factors determining this are the amount of inbreeding and the extent to which the mutant is expressed in the heterozygous state, and of course the amount of reduction in viability and fertility caused by the mutation. The latter factor is impossible to measure in general for human mutations, but very fortunately this factor may be bypassed if the amount of hidden mutational damage is expressed in lethal equivalents. It turns out that the total mutation rate is equal to the total number of lethal equivalents carried by the population multiplied by a factor which we have called z, determined largely by the average amount of heterozygous expression (dominance). The derivation of this relation is given in (4). A desirable feature is that the amount of dominance might be expected to remain reasonably constant in a changing environment, since it is determined by the ratio of the heterozygous to the homozygous damage. Although the two quantities may both be expected to change, their ratio should be fairly constant. Remember that the mutant genes now in the population may have been carried for dozens, or even hundreds of generations. An undesirable feature is that we must go to Drosophila for data and even here the data are not very reliable.

Our best estimate of z from Drosophila data is about .02, though this may easily

be off by a factor of 2. Multiplying this by 4, the number of lethal equivalents in the population, we get .08 as the number of new mutations per individual. In a population of 100 million this would amount to 8 million mutant genes of the class leading to an increased probability of death between birth and sexual maturity.

These two entirely independent procedures have led to results that are reasonably concordant and therefore reinforce each other. The first method led to an estimate of 30 million, the second to 8 million mutants in a population of 100 million. It is to be expected that the first should be larger, since it is based on Drosophila data that include lethals causing death in the egg and early larva stages and which probably correspond to early embryonic lethals in man. Embryonic deaths are not included in the second estimate which is based on human neo- and post-natal death rates. Of course the post-natal and late foetal deaths are of much greater consequence from the standpoint of human welfare.

The human deaths from which the second estimate was made were hardly ever due to obvious genetic anomalies. They had the usual causes, and included a number from tuberculosis and other infectious diseases.

Some General Principles of Radiation Mutagenesis

In every organism where an adequate test has been made radiation has been shown to induce mutations. Other articles in this series will discuss mutations from the standpoint of their chromosomal basis and the effects on the individual. Here I shall summarize only those well established principles needed for this discussion.

1. *Radiation induces mutations.*

2. *Radiation-induced mutations increase almost exactly in proportion to the radiation dose.* To a large extent this is independent of the kind of radiation and wave length. Radiation is conventionally measured in units of the Roentgen, or *r*. (In animal tissue this amounts to about two ionizations per cubic micron; a micron is 1/25,000 inch). At the low doses likely to be encountered in man, "point" mutations would be expected to predominate over gross chromosomal abnormalities.

3. *Although the overwhelming majority of detectable radiation-induced mutations are harmful, most mutations do not result in conspicuous abnormalities.* Careful tests in Drosophila have shown that much the most frequent class of mutation is one that causes a slight impairment in the survival rate. The mutant has somehow rendered the fly more prone to early death. It is also likely that fertility impairing mutants are frequent, but these have not been extensively studied.

These principles, which apply to all experimental animals that have been adequately studied, must surely hold for man as well. There is no reason whatever to think that man is unique in this respect. Furthermore, as will be detailed in the next section, there is some supporting evidence for at least the first principle from direct human studies.

Radiation Studies in Man

Animals studies show that radiation-induced mutations cause the same kinds of abnormalities as spontaneous mutations, so it is not possible to identify an individual abnormality as being radiation-induced. Furthermore, in almost every case a mutational effect can be simulated by an abnormality of non-genetic origin. The situation must surely be the same in man, and the consequence is that radiation damage is manifest simply as an increase in the types of abnormality, disease, and death that are already occurring. This means that genetic effects of radiation can only be detected statistically, with carefully collected data comparing morbidity and mortality rates in otherwise comparable irradiated and control groups.

There have been three such studies. One source of data is the children of Hiroshima and Nagasaki survivors. A sec-

ond is the children of medical radiologists who may be exposed to stray radiation in their work. The third opportunity lies in the study of children whose parents have had heavy X-ray or radium treatments.

The Hiroshima and Nagasaki studies have now been completed and a final report is expected soon (for an earlier report, see 5). Despite the fact that over 80,000 pregnancies were followed, the data are inconclusive. The most recent analysis shows no statistically significant evidence of a genetic effect, as might be shown by increased stillbirths and abnormalities or changes in the sex ratio.

It should be emphasized that genetic effects induced by the bombs would be spread over many generations and would be manifest in many ways, so that only a small fraction of the total effect would occur in a single generation and be of such a nature as to be detected in this study. Another point to be made is that only a small fraction of the births studied were from heavily irradiated parents; most came from areas away from the explosion centers. Therefore the inconclusive results are not surprising. If mutations in man were occurring at the rates found in mice, the effects could probably not have been detected by this study. About the only conclusion is the negative but hopeful one that human germ cells are not grossly more susceptible to radiation than those of mice.

There are two published studies on the families of radiologists (6,7). Both were by questionnaire, and compared radiologists with control groups, mainly pathologists, thought to be comparable in respects other than radiation exposure. In my study there was no significant difference between the miscarriage, stillbirth, or childhood death rates in the two groups. The larger study of Macht and Lawrence showed about 19.8 per cent of the children of the radiologists to be stillborn or abnormal, as compared with 17.3 per cent in the control group (rates adjusted for parity differences). This difference is significant by the usual statistical criteria, but one cannot exclude the possibility that the differences were due to hidden biases of the type likely to be found in any questionnaire study. So this must be regarded as suggestive, but not completely conclusive.

(As an example of a possible type of bias, consider this: The control group responded to the questionnaire less frequently than the exposed group—54 per cent vs. 74 per cent—, while in both groups those respondents who answered only after a second follow-up questionnaire had a higher rate of abnormality. This suggests that where abnormalities exist the parents are more reluctant to answer the questionnaire, so part of the seeming radiation effect may lie in the failure of more in the control group to answer the questionnaire. There are other interpretations, of course, but this illustrates one possible difficulty in interpreting the results.)

More recently Turpin (8) has reported shifts in the sex-ratio in children whose parents had been exposed to heavy pelvic irradiation for therapeutic reasons. Recessive sex-linked mutations would be expected to affect males more than females, where they would be "covered" by their dominant alleles. Since the male gets his X-chromosome from his mother, an effect of sex-linked lethals would appear as a decrease in the proportion of sons from irradiated mothers. Dominant sex-linked lethals would have a contrary effect, for males transmit an X-chromosome only to their daughters. If the effect of the Y-chromosome is negligible compared with the X, the effect of dominant sex-linked lethals would be manifest as a decreased proportion of daughters from irradiated fathers. The data of Turpin, although the total numbers are small, show a statistically significant deviation in this direction, *i.e.*, a larger proportion of male children when the father was irradiated than when the mother was exposed. The significant data are for parents receiving 1000 *r* or more (this is the skin dose; it is hard to

judge the dose to the testes or ovaries).

The Turpin data were also obtained by questionnaire and the response was low. However, one might expect that nonresponse bias would be minimal for an objective criterion like sex-ratio. In any event, the data of Macht and Lawrence and of Turpin both point toward a genetic effect and, I believe, collectively offer direct evidence of an effect in man.

How Much Does Radiation Increase Human Mutation Rates?

The evidence given in the last section makes it almost certain that human mutation rates are increased by radiation. On the other hand, the quantitative information is much weaker. Although we are quite certain that radiation increases the mutation rate in direct proportion to the dose, we are in great doubt as to *how much* increase a certain dose will cause.

The uncertainty has two main causes: (1) The data from man are not good enough to permit any meaningful quantitative statements; neither the measures of dosage nor those of effect are accurate enough. (2) Data from different experimental animals do not agree. For example, typical individual genes in mice mutate some 15–20 times as often as those in Drosophila with the same radiation dose. We have little choice but to adopt provisionally the data from the organism nearest man.

Our nearest relative among those animals for which reliable mutation data exist is the house mouse. Russell's large scale study of seven different genes in mice gave an average of about 25 mutations per 100 million genes per *r*.

The National Academy of Sciences Genetics Committee (2) recommended 10 *r* as a maximum dose for the human population. So I shall use as a convenient reference base a population of 100 million exposed to 10 *r*. Using this base, we can make two kinds of statements.

1. A population of 100 million mice whose parents were exposed to 10 *r* would have $.000,000,25 \times 100,000,000 \times 10 \times 2$, or 500 new mutations at a typical gene locus. (The final factor of 2 comes from the fact that we are assuming that both parents are irradiated, whereas the actual data are based on only one irradiated parent.)

2. In irradiated Drosophila, as mentioned earlier, the total number of detectable detrimental mutations is about 10,000 times the number of mutations at a typical single locus. There are no corresponding data for mice. Using mouse data where possible, and Drosophila data otherwise we may say that a population of 100 million "organisms" exposed to 10 *r* would have 5 million new lethal or detrimental mutations. The "organisms" are hypothetical beasts with the single locus mutation rates of mice, but with the ratio of overall to single locus rate and the death pattern characteristic of Drosophila.

The troublesome question, of course, is: to what extent are these figures applicable to man? And, of course, there is no exact answer. In other branches of biology quantitative extrapolation from experimental animals to man has often been reliable, but occasionally grossly misleading. We can get only the crudest verification from human data, but we can note that if radiation-induced mutation rates in man were grossly higher than these estimates the effects should have been detectable in Japanese data. See (1) for a discussion.

Another question, more meaningful to some, is to ask how much radiation would be required to produce a number of mutations equal to those that occur spontaneously. This is called the rate-doubling dose and may be estimated from the figures given.

In an earlier section the average spontaneous rate for individual mutants in man was taken as 15 per million genes. The corresponding estimate for radiation-induced mutations in mice is 25 per 100 million genes per *r*. Dividing, we get 60 *r*,

as the dose that would cause a number of mutations equal to those that occur spontaneously. This, as all other figures given, is subject to considerable uncertainty.

We can at least place lower limits to this uncertainty. If all spontaneous mutations were due to natural radiation, the doubling dose would be simply an amount of radiation equal to that normally received. In 30 years, the average period from birth to reproduction, the amount of natural radiation received is between 4 and 5 *r*. Thus we can take about 5 *r* as the lower limit of the doubling dose. There is no comparably precise way of setting an upper limit, but this is not so important for if the doubling dose is very high radiation is much less of a potential hazard.

Both the British and American committees independently, and perhaps fortuitously, chose the interval 30–80 *r* as the range within which the doubling dose might reasonably be expected to lie.

Note on Chemical Mutagenesis

In experimental organisms, especially microorganisms, a number of chemicals are known to be mutagenic. Thus far there are numerous inconsistencies among different organisms; for example, substances mutagenic in bacteria have not been shown to be so in Drosophila, though the difference may be due to technical difficulties. Furthermore, there is no information for mammals. This means that one can only guess about the probability that some chemicals in common use may alter the mutation rate. But I want to call attention to the possibility that radiation may not be the only mutational hazard in man.

Summary and Conclusions

This article is a review of some of the ways of estimating mutation rates in man. Using what human data are available, supplementing this with mouse information when human data cannot be used, and relying on Drosophila when neither mice nor humans provide information, the following estimates are arrived at. They are for new spontaneous mutations in a population of 100 million.

1. About 3000 mutations at an average locus. There are reasons for believing that this is an overestimate.

2. About 8 million mutants of the class causing increased probability of death between birth and adulthood, including stillbirths.

3. Perhaps 30 million causing increased probability of death from the time of conception.

Numbers 2 and 3 are based partly on Drosophila data and require several unverifiable assumptions. However, the two estimates are entirely independent.

The following are estimates for radiation-induced mutations in a population of 100 million whose parents were exposed to 10 *r*. These are based entirely on mouse and Drosophila information since there are no quantitatively reliable human data.

1. About 500 mutations at a typical locus.

2. About 5 million new mutations increasing the probability of death from the time of conception.

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THE PATH BETWEEN GENES AND BEHAVIORAL CHARACTERS

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INDIVIDUAL DIFFERENCES IN PERSONALITY are conspicuous in men, dogs, horses and even in such species as white mice or chicken. Geneticists generally accept the idea that part of this variation is the result of hereditary constitutional factors. There is much evidence to bolster this belief. An animal experimenter can produce aggressive or non-aggressive strains of rats by breeding selectively from a miscellaneous group of laboratory animals. The good disposition of present-day laboratory rats is the result of selection of manageable animals by a generation of biologists. If the experimenter is interested in intelligence, he can develop a strain of animals who quickly learn to negotiate a complicated maze. Selection in the opposite direction will produce another strain whose members find great difficulty in learning the maze. It is not intrinsically more difficult to develop stocks with a particular form of behavior than to develop stocks which are large or small, disease resistant or susceptible. In fact, comparative psychologists find that the different breeds of fowl or dogs show patterns of behavior which are almost as good identifying characters as are size, color, and body conformation.

An extreme example has recently been reported in bees. These insects are known to communicate with each other by means of dance activity. Von Frisch has shown that the form of the dances conveys information to other members of the hive regarding the direction and distance of a source of food. Recently it has been found that the style of dance differs in Italian and Austrian bees. The basic mode of communication, the grammar of the language, is the same for both races, but one might fancifully say that the two groups inherit different vocabularies.

Learning probably plays a minor part in the development of bee "language." The situation is quite different in higher animals. Often it seems as though heredity played a part in determining which parts of the environment attracted most attention. This can affect the capacity to learn specific acts. The effects of heredity upon the final behavior are indirect, and predictable only for a particular environment.

The great bulk of investigations on the inheritance of behavioral characteristics in man have utilized the twin study method. Recently, Cattell and others have applied complex methods of analysis to the study of family resemblances in personality which have potentially broader significance than the twin investigations. Most readers are well aware of the difficulties in interpreting observations on humans, where the contributions of heredity and environment are difficult to disentangle. In spite of these difficulties, however, the general conclusion that heredity has a very pervasive effect upon human behavioral variability appears to be justified. The direct studies of family resemblances and the analogy with animal results point in the same direction.

As we become more sophisticated in our approach to the nature-nurture problem, we are no longer satisfied with demonstrating that genetics plays some part in the occurrence of a certain mode of behavior. Take schizophrenia, for example. Numerous studies on the relatives of schizophrenics show a concentration of this disease in families. Environmental causes can, of course, be found, but the same

stresses in a less vulnerable family group do not appear to have as disastrous consequences. Thus, many psychiatrists accept the view that there is an inherited constitutional factor of susceptibility to schizophrenia. This does not rule out the importance of parental rejection or psychological trauma. Complicated diseases have complicated causes. Unfortunately, we have little idea of the nature of this vulnerability, and until some physiological basis is demonstrated the constitutional hypothesis must always be regarded as tenative. Perhaps, after all, there is some very specific combination of experiences not easily detectable in ordinary case histories which could and would produce schizophrenia in every individual exposed to these circumstances.

Since we do not know a physical basis for schizophrenia, we might turn to a consideration of other conditions which offer some clues to the gene-behavior relationship. One of the clearest examples of an interaction between a genetic deficiency and a behavioral character is found in effect phenylketonuria, fundamentally a disorder in the metabolism of the amino acids, phenylalanine. The abnormal metabolic products apparently produce a toxic state in which the brain does not function properly. Some success in the control of this disorder has been reported when individuals were fed diets so low in phenylalanine that fewer toxic products were formed. Knowledge of causes may lead eventually to a workable therapy. In this particular case a behavioral characteristic—here a specific form of mental deficiency—has been linked with an inherited enzymatic deficiency. It is well known that the control of enzyme activity is a major function of genes. In fact, some geneticists believe that all gene effects upon complicated processes will be found, upon close analysis, to depend upon enzymatic processes. One is tempted to consider phenylketonuria as a typical example of genetic effects upon behavior. The search for a pathway between genes and behavioral variability becomes, then, essentially a problem of biochemistry. We should look for metabolic deficiencies in other forms of mental disorders, particularly when they occur predominantly in particular families.

It is likely that this approach will pay dividends and that it will be especially important with regard to well-differentiated specific disorders of behavior. The range of genetic influences upon behavior is, however, much wider than this. Most of the differences between pure animal strains are not really behavioral deficiencies, rather they are matters of different strengths of response or levels of motivation. So-called dull rats, selected because they make many errors in a maze, are not imbeciles. In different kinds of tests they may even surpass the "bright" animals. In our psychological comparison of dog breeds at the Jackson Laboratory we have found no one breed to be consistently superior on all tests. Instead, there are characteristic patterns of abilities which seem to be dependent upon heredity. It may be that enzymatic differences will be found related to these patterns of abilities, but this approach does not seem at the moment to offer the greatest hope for advancement of knowledge. There are just too many possibilities and too few scientists. Instead, it seems that researches at a level between the biochemical and psychological are required. In other words, genetic differences between strains can be made into a tool for physiological psychology.

There has been so little done in this area that any statements must be more a program for the future than an account of established principles. We might start with the inheritance of variation in structure. A great deal is known about the development of the nervous system in men and animals suffering from major inherited deficiencies. However, we cannot point to any structural basis for the difference between "maze bright" and "maze dull" rats, between aggressive and non-aggressive

breeds of dogs, or between Phi Beta Kappas and high grade morons. Perhaps there are none; perhaps we have not looked in the right places. A great deal of new knowledge is available concerning localization of brain function, particularly with respect to emotional behavior whose neural mechanisms are probably similar in man and animals. Investigation into the organic basis of emotional differences in animal strains might throw a great deal of light upon constitutional factors in normal emotionality.

A related area concerns the pattern of emotional response in the periphery of the body. We know that "butterflies in the stomach," headache, high blood pressure, and other symptoms may follow a prolonged psychological stress. These symptoms occur in organs which are not under voluntary control and whose functions are integrated by the division of the nervous system known as the autonomic. Lacy at the Fels Research Institute and Wenger at UCLA have clearly shown that each individual has a characteristic autonomic response which appears to be stable over the years. Our experiments with dog breeds at Bar Harbor have shown that the pattern of autonomic reactivity is a characteristic for each breed, although some overlap is found. If we put all of these results together, we see the outlines of a concept of constitutional differences in physiology which might have a far-reaching effect upon personal adjustment. These effects are not highly specific. Life experience determines the kinds of things to which individuals react strongly. One can still believe in the environmental determination of attitudes. The role of physiological differences lies in the production of the psychosomatic disorders, and in the influence which these in turn have upon behavior. If exposure to stresses results in unpleasant physiological reactions, we learn to avoid stressful situations.

Another path which has been suggested for gene action upon behavior is through the endocrine glands. The effect of hormones upon behavior can be clearly demonstrated in animal material. It is best defined in areas relating to reproduction and care of the young. In many animals the mating drive can be turned off and on by the application of hormones. Interesting experiments by Young at Kansas have shown that the strength of the mating drive is a characteristic of the genetic nature of a strain. Young worked with guinea pigs and developed quantitative methods for measuring the sexual activity of males and females. A certain amount of sex hormone is necessary in both males and females to arouse sexual activity, but additional amounts of hormone do not arouse high drive in a subject which has inherited a low capacity for sexual response. Hormonal effects upon behavior in man are less specific and learning seems to be much more important. The data as a whole suggest that genes may somehow regulate the ultimate level of motivation and that hormones and other chemical factors trigger off a response which has constitutional limits. We should like to see more research upon inherited differences in hormone sensitivity using behavioral measures of hormone effects. Some studies at this laboratory on the effects of cortisone showed that the strain-specific "personality" pattern of mice was very stable in spite of great variations in the amount of hormone.

We have some basis for believing that progress is being made in the analysis of the relation between genetic and motivational characteristics. Whether we are ready for a similar analysis with respect to intellectual capacities is doubtful. We no longer think of intelligence as a single trait, and we recognize it as an abstraction which may be useful for our predicting the success of students in college, or perhaps their likelihood of winning an award on "The $64,000 Question." Modern studies tend to emphasize the numerous factors which go into our concept of intelligence. (See, for example, a report in *Eugenics*

Quarterly, June, 1956 by Vandenberg on the Hereditary Abilities Study at the University of Michigan.) We do not yet know enough about the physical basis of different intellectual abilities to predict what pathways may lie between the genes and these behavioral characteristics. At present, therefore, it would seem that such traits are best studied at a purely psychological level. The investigation of the paths between genes and behavior should concentrate for the time being on the study of motivation. Here, experimental psychologists have many methods, and only a few have been actually employed in psychological genetic investigations. It would be extremely interesting to find out, for example, whether hereditary differences can be shown in the strength of motivations which are not as fundamentally biological as sex and hunger. What about curiosity and gregariousness, for example? Techniques are available which would permit an investigation of these problems in animals and in children. Of course, the more we go beyond the biological motivations we find that we know less about the physiological basis. Hence, such genetic studies must go hand in hand with physiological investigations. There is a great unexplored area between the gene conceived as a biochemical agent and an organism conceived as an individual personality. We can be reasonably sure that the genes have something to do with personality, but the area between is only vaguely known. The author has tried to suggest some areas in which exploration at the present time might prove most profitable. Essentially, this is a plea for considering the physiological aspects of psychogenetics along with the statistical. We need to do more than count the number of individuals suffering from "inherited" psychological defects. We need to know how genes operate in a particular environment to produce healthy or defective personalities.

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ASSOCIATIONS BETWEEN WEIGHT DISCRIMINATION AND HAND PRINTS

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POPULATIONS OF RELATIVELY RECENT HYBRID ORIGIN provide unique material for the detection of linkage, and may thus indirectly bring to light evidence for the genetic bases of variations in human behavior. Although associations between hereditary variations within established and stable populations cannot be considered as evidence for linkage, this principle does not hold for relatively new hybrid populations. Unlike genes belonging to a single alleic series, those at different loci do not attain equilibrium within a single generation within hybrid population but approach it over a number of generations (Rife, 1954a). Moreover, linked genes approach equilibrium more slowly than those located on different chromosomes, the rate of approach in linked genes being inversely proportional to the closeness of the linkage.

Suppose the parent populations of a hybrid one differ greatly in the frequencies of each of three pairs of alleles (*Aa*, *Bb*, and *Cc*). Let us further suppose that two of these sets of alleles (*Aa* and *Bb*) are closely linked, whereas the third set (*Cc*) is located on another pair of chromosomes. This will result in a higher and more persistent association between *Aa* and *Bb*, than between either *Aa* and *Cc*, or *Bb* and *Cc* within the hybrid population. In other words, higher and more persistent associations between some hereditary variations than between others within mixed populations may be considered as evidence for linkage between the former. This is especially true if the traits under consideration play no part in the selection of marriage partners, and if the associations are absent in stable populations, or vary in expression from one hybrid population to another. Associations of this sort were recently found between patterns of the second interdigital area of the palm and shade of pigmentation within populations of mixed Negro-White origin (Rife, 1954b).

The foregoing methodology need not be restricted to the detection of the linkage relationships between known genes but may be extended to include traits whose possible heritabilities are as yet unsolved. It could be especially useful in the investigation of the role of heredity in bringing about variations in behavior, for it is difficult to visualize how nongenetic factors could bring about persistent associations with some simply inherited variations and not with others, within populations of hybrid origin, having essentially the same cultural background. During the past year the author had an opportunity to investigate three African populations of mixed origin for associations between simply inherited variations and behavior. These included 130 prisoners in Zanzibar; 51 Goans at the Kololo Secondary School in Kampala, Uganda; and 135 Cape Colored people in Capetown, South Africa. This paper is concerned with a preliminary report of the findings.

The Zanzibar Prisoners

The prisoners at Zanzibar were almost entirely of East African Bantu-Arab origin, with a preponderance of the former. Arabs and Bantu intermarry quite frequently, and varying degrees of intermixture were apparent among the prisoners. The majority were completely illiterate. Data were obtained on the following traits; ABO blood groups, cell sickling, finger and palm prints, stature, length of fingers, length of tibiae,

and discrimination of differences in weight. The last item required the subject to arrange three small boxes of the same size (approximately .5 cubic inches each) in order of their weights, from light to heavy. Their respective weights were 5, 6, and 8 grams. Among the 130 persons tested, 48 arranged the weights correctly, 82 incorrectly. No significant associations were found between ability to discriminate between weights and any of the physical traits employed.

The Goans

The Goans are largely of mixed Indian and Portugese descent, with the physical characteristics of Indians predominating. The Kampala Goans are almost entirely Roman Catholic and live largely within their own community, having their own societies, churches, and primary schools.

Data obtained from the 51 students included the ABO blood groups, palm and finger prints, a form board test consisting of 88 items which the subject attempts to assemble in 7 minutes,[1] and the same weight discrimination test which was administered to the prisoners at Zanzibar. They rated much better on the weight discrimination test than did the prisoners at Zanzibar, 32 out of the 51 subjects doing it correctly.

No significant associations were found between either the blood groups or the hand prints with the form board test results, nor were either the blood groups or the form board tests found to be associated with performance on the weight discrimination test.

Tables 1, 2, 3, and 5 show the results of tests for association between hand prints and weight discrimination in each of the three mixed populations. In all of the tables and throughout the remainder of the paper, C symbolizes the group which was successful in the weight discrimination test, and I the group which failed it. Note that there is no evidence for associations between palm patterns and weight discrimination in the Goans, but that there is a marked difference between groups C and I in the incidence of whorls on fingertips, members of group C in having over 15 per cent more than group I. The difference in the mean number of whorls per person of C and I groups is 1.5 ± 0.70, a significant amount, although not highly so. Arches occur in a slightly lower frequency in group C. The higher frequency of whorls in group C is reflected in a higher ridge count (Table 5), but here the difference is statistically insignificant.

The Cape Colored

The colored people in Capetown are chiefly a mixture of Malay and Hottentot-Bushman, with some infusion of Bantu and European ancestry. Dr. Ronald Singer, of the Department of Anatomy at the University of Capetown, arranged for and assisted the author throughout in working with 135 Cape Colored people. These consister of 35 employees of the Medical School (sample 1 in the tables), and 95 male patients and 5 female nurses at the Brooklyn Tuberculosis Infirmary (sample 2) at Capetown. Hand prints were taken, and each person was tested for ability to discriminate between the weights. Group C includes 76, and group I includes 59 persons.

Tables 1, 2, and 3 reveal marked associations within both samples of Cape Colored between inability to discriminate between weights and the incidence of arches on fingertips, and also between ability to discriminate between weights and the incidence of palm patterns. Table 5 reveals a statistically significant difference in the mean ridge counts of C and I groups, C being higher. Table 4 shows that the higher incidence of arches among population I within the Cape Colored is attributable to a widespread distribution, rather than to only a few individuals manifesting high frequencies of them. This is not true

[1] A group performance kindly loaned to me by the National Foundation for Educational Research in England and Wales.

TABLE 1

FREQUENCIES OF WHORLS, LOOPS, AND ARCHES ON THE FINGER TIPS OF ZANZIBARIANS, GOANS, AND CAPE COLORED POPULATIONS, IN BOTH C AND I GROUPS

Population	C				I			
	Number of individuals	Whorls	Loops	Arches	Number of individuals	Whorls	Loops	Arches
Zanzibarians	48	33.68%	63.59%	2.73%	82	32.26%	61.44%	6.30%
Goans	32	53.44	43.44	3.12	19	38.36	57.96	3.68
Cape Colored								
Sample 1	21	37.86	59.23	2.91	14	27.14	65.01	7.85
Sample 2	55	30.79	66.43	2.78	45	29.43	62.80	7.77
Total	76	32.10	65.14	2.76	59	28.81	63.40	7.79

TABLE 2

FREQUENCIES OF INDIVIDUALS POSSESSING ONE OR MORE PATTERNS ON THENAR/FIRST INTERDIGITAL AREAS AMONG ZANZIBARIANS, GOANS, AND CAPE COLORED POPULATIONS, IN BOTH C AND I GROUPS

Population	C			I		
	Number of individuals	One or more patterns	No patterns	Number of individuals	One or more patterns	No patterns
Zanzibarians	48	22.81%	77.19%	82	26.83%	73.17%
Goans	32	18.75	81.25	19	36.84	63.16
Cape Colored						
Sample 1	21	23.80	76.20	14	0.00	100.00
Sample 2	55	27.27	72.73	45	15.55	84.45
Total	76	26.31	73.69	59	11.89	88.11

TABLE 3

FREQUENCIES OF INDIVIDUALS POSSESSING ONE OR MORE PATTERNS ON SECOND INTERDIGITAL AREAS AMONG ZANZIBARIANS, GOANS, AND CAPE COLORED, IN BOTH C AND I GROUPS

Population	C			I		
	Number of individuals	One or more patterns	No patterns	Number of individuals	One or more patterns	No patterns
Zanzibarians	48	27.08%	72.92%	82	20.73%	79.27%
Goans	32	9.37	90.63	19	10.42	89.58
Cape Colored						
Sample 1	21	23.80	76.20	14	0.00	100.00
Sample 2	55	23.60	76.40	45	11.11	88.89
Total	76	23.68	76.32	59	8.47	91.53

TABLE 4

NUMBERS OF INDIVIDUALS POSSESSING ONE OR MORE ARCHES AMONG ZANZIBARIANS AND CAPE COLOREDS

	C		I				
	Number persons having one or more arches	Number lacking arches	Number persons having one or more arches	Number lacking arches	X^2	df	p
Zanzibarians	7	41	14	68	0.15	1	$>.95$
Cape Colored	8	68	15	44	5.32	1	$<.05$

TABLE 5

MEAN RIDGE COUNTS ON FINGER TIPS OF ZANZIBARIANS, GOANS AND CAPE COLOREDS, AMONG BOTH C AND I GROUPS

Population	Number individuals	Mean number of ridges per person			Differences in mean values		
Zanzibarians							
C	43	138.16	±	6.57			
I	71	136.91	±	6.73	1.25	±	9.40
Goans							
C	32	210.90	±	10.98			
I	19	197.78	±	16.31	13.12	±	19.66
Cape Colored							
C	64	159.09	±	6.08			
I	52	131.34	±	9.12	27.75	±	10.956

The numbers of individuals in some of the above categories are fewer than in the other tables, due to blurred and incomplete prints on some individuals, thus rendering accurate counts impossible. Such cases could not be included.

TABLE 6

FREQUENCIES OF INDIVIDUALS AMONG THE CAPE COLORED POSSESSING ONE OR MORE PATTERNS ON THENAR/FIRST AND SECOND INTERDIGITAL AREAS, AND THE SIGNIFICANCE OF DIFFERENCES BETWEEN C AND I GROUPS

Pattern area	I		C				
	Number persons with one or more patterns	Number persons lacking patterns	Number persons with one or more patterns	Number persons lacking patterns	X^2	df	p
Thenar/first interdigital	20	56	7	52	4.34	1	$<.05$
Second interdigital	17	59	5	54	4.65	1	$<.05$
Either one or both of the above areas	34	42	12	47	8.58	1	$<.01$

of the Zanzibar population. The magnitude of the differences among both samples of Cape Colored in the occurrence of ridge counts, arches, and palm patterns in populations C and I seems to establish beyond any reasonable doubt that they are real, and not due to chance fluctuations.

Discussion

Two out of the three hybrid populations which were investigated revealed significant associations between the ability to discriminate between weights and the incidence of patterns on hands. Whorls are the most highly developed patterns, and arches are actually patternless configurations. Among both Goans and Cape Coloreds pattern intensities on fingertips are higher among the C than among the I groups. This difference is expressed among the Goans by significant differences in the incidence of whorls, among the Cape Colored by corresponding differences in the frequencies of arches in C and I groups. Arches occur with slightly higher frequencies in the I than in the C group of Goans, while whorls occur less frequently in the I than in the C group of Cape Coloreds. These trends are illustrated in Table 1.

These differences are consistent with the rule that in populations throughout the world the incidence of arches varies inversely with that of whorls. African Bushmen have among the highest frequencies of arches known, slightly exceeding that of whorls. The fact that they comprised one of the major components of the ancestry of the Cape Coloreds likely accounts for the

TABLE 7

FREQUENCIES OF INDIVIDUALS AMONG THE CAPE COLORED POSSESSING PATTERNS IN EITHER OR BOTH THENAR/FIRST AND SECOND INTERDIGITAL AREAS AND LACKING ARCHES, AND SIGNIFICANCE OF DIFFERENCES IN C AND I GROUPS

C		I				
Number persons with T/I or II patterns, no arches	Number persons lacking patterns or having arches	Number persons with T/I or II patterns, lacking arches	Number persons lacking patterns or having arches	X^2	df	p
29	47	8	51	10.07	1	<.01

TABLE 8

THE DISTRIBUTION OF C AND I GROUPS AMONG EACH OF THE THREE MIXED POPULATIONS

	Zanzibarians	Cape Colored	Goans	Total	X^2	df	p
C	48	76	32	156	16.23	2	<.005
I	82	59	19	160			
Total	130	135	51	316			

marked difference in the incidence of arches in the C and I groups. Goans, as well as other Asians, are characterized by relatively high frequencies of whorls and low frequencies of arches, which may account for the wide difference in the incidence of whorls rather than arches, between C and I groups.

Ridge counts are used as another criterion of pattern intensity, and they are correlated to some extent with the incidence of whorls. Arches always have a ridge count of zero, and whorls tend to have higher numbers of ridges than do loops. Moreover, ridge counts have the highest heritability of all dermatoglyphic configurations (90 per cent in dizygotic twins according to Holt, 1952). Absence of a statistically significant difference between C and I groups of Goans in ridge counts, plus low significance of the difference in the percentages of whorls raises doubt as to whether or not these differences are real. But there is little or no room for doubt concerning the significance of the differences observed among the Cape Colored. The difference in the mean ridge count values of C and I groups is almost 2.6 times the standard error, indicating the odds are approximately 99 to 1 against it being due to chance alone.

The Cape Coloreds also show highly significant associations between patterns (loops, whorls, and vestiges) on the thenar/first and second interdigital areas of the palm and weight discrimination. These differences are statistically significant on each of these areas, and are highly significant when pooled (Table 6).

The thenar/first interdigital and second interdigital areas are adjacent to each other, and patterns have higher heritabilities here than in other palmar areas. Moreover, it has been established that positive correlations exist between patterns in these two areas (Cummins and Midlo, 1943). Correlations exist not only between the incidence of patterns in these areas but also between intensities on fingertips and on the second interdigital area (Rife, 1943). Table 7 shows comparisons of the pooled incidence of patterns among individuals within the thenar/first interdigital and second interdigital areas, plus the absence of arches. These differences between the C and I groups are the most significant of all.

Finger and palm patterns are highly heritable and are established long before birth. Moreover, they are of no known

selective importance. The Cape Colored people live under similar environmental circumstances, having attended the same schools and having been exposed to somewhat the same cutural influences throughout their lives. In view of these circumstances it seems impossible to account for the associations between hand patterns and weight discrimination performance on an environmental basis. Variations in the degree of association from one hybrid population to another, plus the absence of any associations between blood groups or anthropometric variations with either weight discrimination or the form board performance test strongly suggest linkage between genes responsible for hand patterns and ability to discriminate between weights. This implies, of course, that most likely there is a genetic basis for ability to discriminate between weights.

Evidence for heredity by no means rules out environment as a factor. Table 8 shows highly significant differences in the percentages of individuals in the C group of each of the three hybrid populations. Note that the Zanzibar population has the lowest percentage, while Goans show the highest percentage in the C group. The Zanzibar group is the most illiterate, while the Goan population is the most literate of the three. The differences in percentages of C in the three populations are highly significant and suggest that education may improve one's ability to discriminate between weights. But it must be kept in mind that the three populations are of quite different racial origins, which may also be an important factor in bringing about differences in performance.

Summary

Samples of the three populations of hybrid origin (Zanzibarians, Goans, Cape Colored) were tested for associations between heritable physical variations and the ability to discriminate between small weights. No such associations were found among the Zanzibarians. A significant association was found among Goans between the incidence of whorls on finger tips and ability to discriminate between weights. Highly significant associations were found between both finger and palm prints and weight discrimination among the Cape Colored. These findings indicate a genetic basis for differences in the ability to discriminate between small weights.

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ILLEGITIMACY IN FLORIDA

I. Reported Illegitimate Births In Florida, 1917-1953

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II. Social and Psychological Aspects of Illegitimacy

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I. REPORTED ILLEGITIMATE BIRTHS IN FLORIDA 1917-1953

THE BUREAU OF VITAL STATISTICS of The Florida State Board of Health has collected illegitimacy statistics in conjunction with the recording of births since the inception of the bureau in 1917. This paper will present a statistical analysis of several aspects of these data.

Source of Data

Information concerning legitimacy is supplied by the mother to the doctor, midwife or other person attending the birth and is subject to an uncertain degree of misrepresentation. There is probably considerable concealment of the true facts by unwed mothers and some by the attendants as well. Bias introduced into the data by this factor and other limitations of the data will be discussed in subsequent paragraphs. Since 1949, legitimacy information has been placed on a confidential section of the original birth record which is not photographed when certified photostatic copies of the certificates are issued. It is believed that this confidentiality materially strengthens the accuracy of the reporting of this item.

Statistics on reported births and legitimacy for selected years are presented in table I.

Statistical Measures

Changes in reported illegitimacy over time may be appraised by the use of several statistical measures:

1. The trend of the absolute number of illegitimate births.
2. The trend of the illegitimate birth rate.
3. The trend of the illegitimacy ratio.
4. The trend of the specific illegitimacy rate.

Illegitimate Births

1. The number of illegitimate births, both white and non white, has exhibited a steady upward trend over the years. In terms of work for social welfare agencies concerned with the problems of unwed mothers and their offspring, this has meant an ever increasing case load in this field in addition to increased work resulting from other growing social problems. In view of the rapid growth of Florida's population this trend may be expected to continue, and further increases in the need for the services of these organizations in this field may be anticipated.

The Illegitimate Birth Rate

2. The trends of reported illegitimate

TABLE I

BIRTHS, ILLEGITIMATE BIRTHS, BIRTH RATES, ILLEGITIMATE BIRTH RATES AND ILLEGITIMACY RATIOS, BY RACE, FLORIDA, SELECTED YEARS

Year	Births				Illegitimate Births				Illegitimacy Ratio (b)	
	Number		Rate (a)		Number		Rate (a)			
	White	Non White	White	Non White	White	Non White	White	Non White	White	Non White
1917	12,701	5,220	22.8	16.1	126	587	0.23	1.81	9.9	112.5
1920	13,541	5,999	20.6	17.9	125	629	0.19	1.88	9.2	104.9
1925	20,076	9,225	23.6	23.9	280	1,021	0.33	2.65	13.9	110.7
1930	18,596	8,395	17.8	19.3	277	1,190	0.27	2.74	14.9	141.8
1935	19,596	8,462	17.0	18.0	327	1,493	0.28	3.18	16.7	176.4
1940	23,805	9,891	17.0	19.1	358	1,717	0.26	3.32	15.0	173.6
1945	36,217	12,622	21.1	22.7	620	2,303	0.36	4.13	17.1	182.5
1946	40,799	13,548	22.5	23.9	726	2,536	0.40	4.47	17.8	187.2
1947	44,933	15,268	23.6	26.4	729	2,975	0.38	5.15	16.2	194.9
1948	43,336	16,349	21.7	27.8	712	3,326	0.36	5.66	16.4	203.4
1949	44,385	17,257	21.2	28.9	761	3,603	0.36	6.03	17.1	208.8
1950	45,699	18,671	20.9	30.7	805	4,329	0.37	7.12	17.6	231.9
1951	50,446	19,985	22.1	32.3	916	4,823	0.40	7.81	18.2	241.3
1952	53,589	20,630	22.5	32.9	1,013	4,976	0.43	7.92	18.9	241.2
1953	58,262	21,825	23.6	34.2	1,111	5,429	0.45	8.51	19.1	248.8

(a) Rate per 1,000 population.
(b) Illegitimate births per 1,000 births.
Years 1917-1930 are recorded, 1935-1953 resident.

births by race in relation to population as indicated by the crude illegitimate birth rates are shown in chart I. These rates have been plotted on a semi-logarithmic (ratio) scale and indicate the relative change in each rate from year to year. In all years, the non white illegitimacy rates exceed the white. The disparity undoubtedly reflects a true differential in the relative number of illegitimate births in each population group. However, since there is certainly some concealment of illegitimacy by members of both races, neither rate may be taken as indicative of the absolute extent of illegitimacy. It is probable that some of the difference in rates by race results from a greater degree of concealment on the part of unwed white mothers. Sam Shapiro in his study of illegitimacy in the United States for the period 1938 to 1947 has attributed part of the difference in rates to the greater ability (economic or otherwise) of the white mothers to leave their home community before the birth of the child and thus conceal the fact of illegitimacy.

The differing attitudes of the two racial groups toward illegitimacy are probably also important factors in the degree of concealment by each race, as well as the principal factor in the true differential of the rates. An illegitimate birth does not stigmatize a child in the southern Negro community as it does in white society. The informal living together of man and woman is more common in the Negro than in the white group in the South. The failure to formalize a marriage does not, in many Negro communities, lower the social positions of the parties concerned, and this too tends to increase the reported illegitimacy rates among Negroes.

As indicated by chart I, rises and falls in the white birth rate tend to be accompanied by similar rises and falls in the white illegitimate birth rate. An exception to this is the period of World War II when the illegitimate white rate dipped sharply, possibly under the stimulus of allotments for the legitimate dependents of service personnel.

The non white illegitimate rate curve follows the general shape of the non white birth rate curve, but exhibits a somewhat sharper rate of increase.

It would appear that those social and

REGISTERED BIRTHS AND ILLEGITIMATE BIRTHS PER 1,000 POPULATION, BY RACE, FLORIDA, 1917-1953

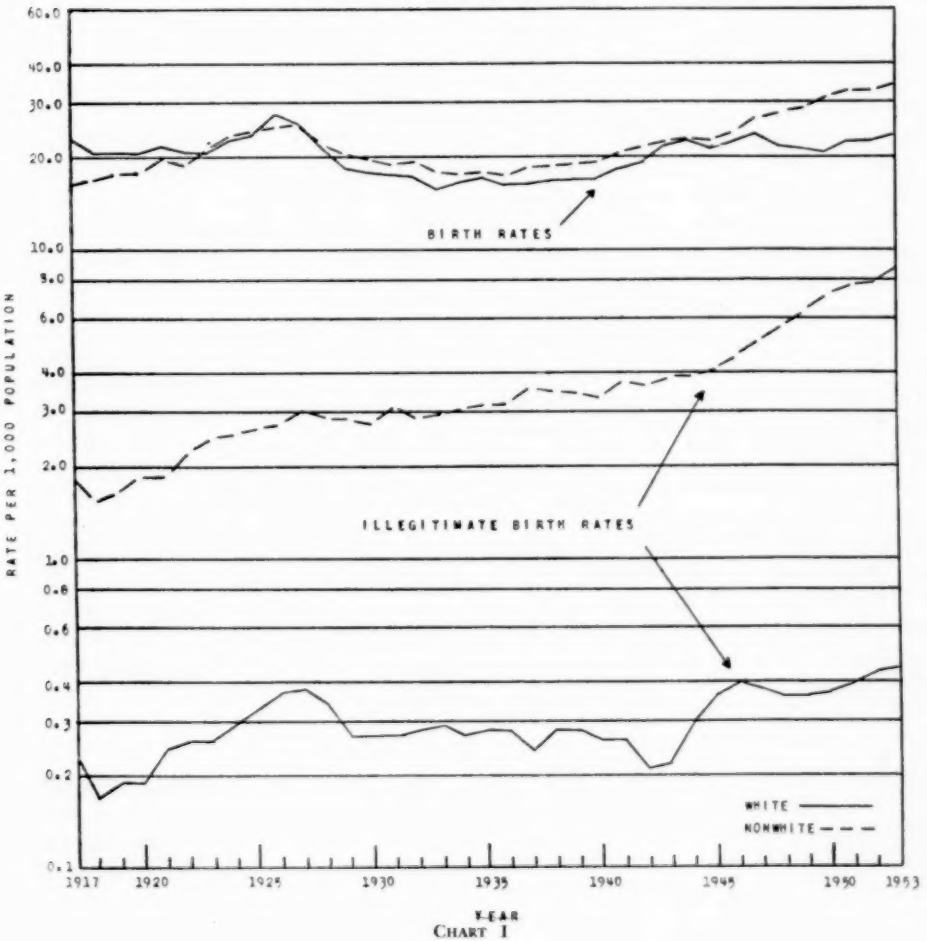

CHART I

economic forces which effect changes in the legitimate birth rate also affect the number of illegitimate births.

The Illegitimacy Ratio

3. Although the levels of legitimate and illegitimate births are definitely interrelated, illegitimacy as a distinct problem may be measured by use of the illegitimacy ratio: the number of illegitimate births per 1,000 births. The ratios for the white and non white races for selected years are presented in table I and are also indicated by the relative size of the gap between the trend lines of the birth rates and the illegitimate birth rates in chart I.

Over the long period from 1917 to 1953 the trend of the illegitimacy ratio has been generally upward for both races. However, this trend must be interpreted with caution. During this period, and especially during the years of World War II and after, there has been a considerable improvement in the completeness of the reporting of births

in Florida. This change may account for some of the increase in the ratio. Studies conducted in conjunction with the 1950 census indicate that in Florida the registration of white births was 98.8 percent complete in that year compared to 91.3 percent in 1940. The registration of non white births was 94.1 percent complete in 1950 and only 86.4 percent complete in 1940. There is a distinct possibility that the increase in completeness of registration has resulted to a great extent from the increased registration of illegitimate births.

Some of the increase may also have resulted from the raising of standards for the acceptance of certificates by the Bureau of Vital Statistics. This raising of standards has made the concealment of illegitimacy more difficult.

Another factor affecting the illegitimate birth rate is the increased interest in recent years of social welfare agencies in aiding unwed mothers and their offspring, and in the placement of children for adoption. The interest of these agencies and the adoption courts has required the keeping of more accurate records.

In the post war period beginning in 1945 the white illegitimacy ratio dropped from a level of 17.1 to a low of 16.2 in 1947 and has risen steadily from that point to the present figure of 19.1. The non white ratio was 182.5 in 1945, and has increased each year to the 1953 level of 248.8, an increase of 36.3 percent.

The Specific Illegitimacy Rate

4. The upward trend of illegitimacy is further emphasized by the specific illegitimate birth rates presented below. The specific illegitimate birth rate has as its base the number of unmarried women in the child bearing ages, 15 through 44.

Despite the factors indicating improved reporting of illegitimacy, an upward trend of the magnitude indicated by the specific rates and the illegitimacy ratio must be regarded as real increase in illegitimacy.

SPECIFIC ILLEGITIMATE BIRTH RATES PER 1,000 UNMARRIED WOMEN AGED 15-44, FLORIDA, CENSUS YEARS

Race	Year			
	1920	1930	1940	1950
White	2.5	3.3	3.2	6.8
Non White	20.5	27.1	33.2	97.8

Characteristics of Illegitimate Births

In addition to trend figures, comparative data for legitimate and illegitimate births for age of mother, birth order and attendant at birth are available for 1953.

Age of Mother

The distributions of the age of mother for legitimate and illegitimate births by race, and illegitimacy ratios by age are presented in table II. In general, illegitimacy ratios are higher at younger ages. The mothers of illegitimate children were a younger group than the mothers of legitimate children. The age distribution of non white mothers of both legitimate and illegitimate children shows a higher concentration in the age group 15 to 19 when compared with the corresponding white group.

Birth Order

The distributions of legitimate and illigitimate births by birth order, and of illegitimacy ratios by birth order are presented in table III. Illegitimate births for both races were generally of a lower order than legitimate births. White births, both legitimate and illegitimate, tend to be concentrated in earlier birth orders when compared with the corresponding group in the non white race. Illegitimacy ratios are distinctly higher for first order births for both races.

Attendant at Birth

A small number of illegitimate white births (24) was attended by midwives. This figure represented 2.2 per cent of the total of illegitimate white births and compares with 1.1 per cent for the legitimate white

TABLE II

DISTRIBUTION OF LEGITIMATE AND ILLEGITIMATE BIRTHS BY AGE OF MOTHER AND RACE, AND ILLEGITIMACY RATIOS BY AGE OF MOTHER, FLORIDA, 1953

	Number				Illegitimacy Ratio*		Percent Distributions**			
	White		Non White				White		Non White	
Age	Legitimate	Illegitimate	Legitimate	Illegitimate	White	Non White	Legitimate	Illegitimate	Legitimate	Illegitimate
TOTAL	57,151	1,111	16,396	5,429	19.1	248.8	100.0	100.0	100.0	100.0
Under 15	21	12	29	165	363.6	850.5	0.0	1.1	0.2	3.0
15 - 9	7,005	364	2,452	2,086	49.4	459.7	12.3	32.9	15.0	38.4
20 - 24	18,431	385	5,055	1,385	20.5	215.1	32.3	34.8	30.9	25.5
25 - 29	16,397	175	4,344	910	10.6	173.2	28.7	15.8	26.5	16.8
30 - 34	9,910	103	2,775	513	10.3	156.0	17.3	9.3	16.9	9.5
35 - 39	4,324	54	1,314	283	12.3	177.2	7.6	4.9	8.0	5.2
40 - 44	996	13	384	80	12.9	172.4	1.7	1.2	2.3	1.5
45 - 49	43	0	29	4	0	121.2	0.1	0	0.2	0.1
50 and over	1	0	0	1	0	1000.0	0.0	0	0	0.0
Unknown	23	5	14	2	178.6	125.0				

*Illegitimate births per 1,000 live births.
**Unknown ages excluded.

TABLE III

DISTRIBUTION OF LEGITIMATE AND ILLEGITIMATE BIRTHS BY BIRTH ORDER AND RACE, AND ILLEGITIMACY RATIOS BY BIRTH ORDER, FLORIDA, 1953

	Births				Illegitimacy Ratio*		Percent Distributions**			
	White		Non White				White		Non White	
Birth Order	Legitimate	Illegitimate	Legitimate	Illegitimate	White	Non White	Legitimate	Illegitimate	Legitimate	Illegitimate
TOTAL	57,151	1,111	16,396	5,429	19.1	248.8	100.0	100.0	100.0	100.0
First	18,339	759	2,411	2,082	39.7	463.4	32.1	68.6	14.7	38.4
Second	16,426	181	3,053	1,124	10.9	269.1	28.8	16.3	18.6	20.7
Third	11,436	83	2,915	670	7.2	186.9	20.0	7.5	17.8	12.3
Fourth	5,377	41	2,379	525	7.6	180.8	9.4	3.7	14.5	9.7
Fifth	2,513	20	1,730	348	7.9	167.5	4.4	1.8	10.6	6.4
Sixth	1,280	14	1,224	226	10.8	155.9	2.3	1.3	7.5	4.2
Seventh	711	5	873	157	7.0	152.4	1.3	0.4	5.3	2.9
Eighth	416	2	589	107	4.8	153.7	0.7	0.2	3.6	2.0
Ninth or greater	580	2	1,204	185	3.4	133.2	1.0	0.2	7.4	3.4
Unknown	73	4	18	5	51.9	217.4				

*Illegitimate births per 1,000 live births.
**Unknown orders excluded.

births. Higher percentages of non white births, both legitimate and illegitimate, were attended by midwives. The legitimate non white percentage was 31.9 and the illegitimate 37.7.

Summary and Conclusions

1. The trend of illegitimacy in Florida as indicated by various statistical measuring devices has been generally upward, especially in recent years.

2. The rate of illegitimacy is greater in the non white race.

3. Reported illegitimate births may be expected to grow in number because of the upward trend of population. A continuance of the present rising trend of the illegitimate birth rates and ratios will intensify the growth.

4. Young mothers giving birth to their first child account for the largest proportion of illegitimate births.

5. There appears to be no important difference in the attendant chosen by mothers giving birth to legitimate offspring and the attendants at illegitimate births.

II. Social and Psychological Aspects of Illegitimacy

In the foregoing well-balanced statistical

analysis of reported illegitimate rates in Florida, Williams and Thorner have stressed the fact that the increase in the rate of illegitimacy and the difference between the white and non white rates is probably more apparent than real. The purpose of this section is to discuss further this and other aspects of illegitimacy.

The illegitimacy ratios for the United States as estimated by Sam Shapiro of the National Office of Vital Statistics for 1938-1947 are generally comparable to those for Florida for the same period. In other words, about four births in 100 each year in the United States are illegitimate. Of these, something less than two in 100 are white and 17 in 100 are non white. For the ten-year period 1938-1947, about two-thirds of a million illegitimate children were born in the United States; and because of the increase in the population, more than a million will be born in the subsequent decade. The similarity of the national and the Florida figures in recent years indicates that the increased Florida ratio of illegitimate to legitimate births may reflect primarily a more effective system of reporting and only secondarily an actual increase in the rates. The recent stability of the national figures suggests that the conditions producing illegitimacy are also relatively constant. Although only some of the factors influencing illegitimacy are known, they and others to be revealed by further study must be viewed in a complex of legal, psychological, and sociological terms.

Illegitimacy is legally defined in terms of marriage since it means the birth out of wedlock of a child. Generally speaking, legitimacy and illegitimacy differ in that between the illegitimate child and its mother *only* there exists the legal status of parent and child which in a legitimate birth exists between the child and *both* parents.

That there are in Florida two ways of legally entering marriage, either by statutory or by common law procedure, materially influences the illegitimacy rates. With certain exceptions, a statutory marriage is established through a legally prescribed procedure of license, blood test, wedding ceremony, and cohabitation. A record of this marriage is filed in the county in which the ceremony is performed and a copy is sent to the Bureau of Vital Statistics, Florida State Board of Health. A common law marriage is created by a couple living together and being recognized as man and wife by others in the community. A common law marriage is just as legally binding as a statutory marriage, which means among other things, that it cannot be dissolved except by death or divorce, and that the children are legitimate. From the standpoint of the individuals concerned, the major drawback of a common law marriage is that there is no legal record of it such as in a statutory marriage, and should any legal question concerning it arise, such as inheritance or the legitimacy of the children, its existence must be proved by other means.

It seems true that many couples, though probably considerably more Negroes than whites, do not realize that they have established a common law marriage. Hence, children born of these unions are reported illegitimate when legally they are legitimate. If these births were correctly recorded, the illegitimate rates for whites and especially non whites would decrease and the difference between the two would be less. It should be noted, however, that for this same reason there are some births which are reported legitimate when in fact they are illegitimate. This situation arises both from the ignorance of the existence of a common law marriage, as just described, and from the false notion that a common law marriage is dissolved by separation of the partners, the so-called "common law divorce." In some of these instances a person will subsequently enter into a statutory marriage with another person without having a previous common law marriage (which they may have created wittingly or unwittingly) dissolved by death or divorce. In these cases the second marriage which

the individual considers to be *the* legal marriage is void, the person involved in the two marriages is guilty of bigamy, and the children born of the second union are illegitimate even though the other spouse may not have been previously married and was ignorant of the other's status.

Although the status of illegitimacy usually carries a degree of social stigma for child and mother, public opinion seems considerably more lenient today than a generation or two ago. Some problems of illegitimacy have been slightly alleviated in certain states by legal enactments. About one-third of the states have eliminated the question of legitimacy from the birth certificate or placed it on a confidential section of the record as is done in Florida.

Two states, Arizona and North Dakota, have attempted to grant equal rights to all children by enacting laws declaring that every child is the legitimate offspring of its natural parents. Although these laws presumably give to the child born out of wedlock more legal status, such as the right to support and to inherit from the father as well as the mother, most of the conditions of what would be illegitimacy in other states remain because the child is not born within a marriage unit. All states except Texas and Virginia have laws which may require a father to support fully or partially his illegitimate child, but it must be remembered it is usually difficult to prove paternity in these bastardy proceedings. The Florida law provides, for example, that the father pay attorney fees, hospital and medical expenses, and allowance for the upkeep of the child, the amount of which is set by the court.

Although there is a widespread belief to the contrary, a man cannot be forced legally to marry a woman because of paternity or of any other reason because this action would be duress and it would violate the basic legal concept of marriage which rests upon the mutual consent freely given of the couple concerned.

The extent to which illegitimacy is a social problem varies considerably. Among many Negro groups in the South, as was mentioned in the other section of this paper, and among some whites, an out of wedlock birth carries no social stigma for mother or child, and it creates no particular emotional disorders for them. In fact, in many instances the Negro mother has no desire to marry even though the father may have asked her, because it would mean for her the giving up of a much cherished independence. Sometimes, however, the financial problem of caring for the child may become great or even unbearable particularly with the growing up of the child or with the addition of other children. On the other hand, in the birth of an illegitimate child into a middle class, southern white family, the financial difficulties may be quite incidental, but the social stigma may be enormous and the emotional crisis may be shattering. There is intended here no implication that one of these problems is solely typical of one, but not the other group, but rather that one is more characteristic of one than the other. Emotional problems of illegitimacy for the Negro family and financial ones for the white are often quite traumatic.

Most case studies and statistical analyses, including those for Florida (table II) and for the United States, reveal that *on the average* unmarried, as compared to married, mothers of both white and non white races are younger and less well educated, and more come from the lower social classes. More recent studies strongly suggest that these differences are probably more apparent than real because unwed mothers of the middle and upper class are more able to hide the birth of an illegitimate child by having it delivered away from home under secret or at least very discreet conditions. This conclusion is borne out in the findings of Clark Vincent in a comparative study of unwed mothers in California whose children were delivered in private practice and of those whose children were born in a Salvation Army hos-

pital. Of the mothers who were delivered in private practice as compared with those who were delivered in the charity hospital, more were 22 years of age or older and fewer were 17 years of age or younger; more of their alleged sexual partners were 26 years of age or older; more had attended college and fewer had not completed high school. He also found that the higher the educational attainment of the unwed mother, the more likely that she came from out of state to have her baby. Little is known about the fathers of illegitimate children. The study of Ruth Reed suggests that they may be older and of a higher educational level than the mothers, and by implication of a higher social class.

The explanations of why a girl or woman has an illegitimate child have varied according to our moral beliefs and our scientific knowledge of human behavior. Traditionally it was taken for granted that women had an illegitimate child because they had sinned and they were paying for their sins. Only in the more flagrantly exceptional case was there expressed a more charitable attitude that a young maiden had been seduced, wronged, and, of course, "ruined" even though a helpless innocent. With the modern development of the studies of human behavior explanations of illegitimacy have been sought in social and psychological terms. Studies made a quarter of a century ago stressed immorality, mental deficiency, poverty, slums and broken homes, whereas those made recently are concerned with cultural patterns and psychological processes.

Leontine Young emphasizes in her provocative analysis of over thirteen hundred case histories of illegitimate births that a basic error which had been made prior to the acceptance of Freudian and other modern concepts of human behavior as purposive was that the out of wedlock baby was considered merely an unwanted and accidental by-product of the mother's sexual conduct when in fact it seems that in most cases having the child is the real, though unrecognized, motive. She develops the thesis with voluminous illustrations that most, but not all, girls having illegitimate children subconsciously want the out of wedlock child because of deep-seated psychological needs, although they are completely unaware of these desires at the conscious level and they are shocked, terrified, or surprised over what has happened to them. Young believes that the two major groups of girls in this category are those who are completely dependent upon a domineering mother and those who are in revolt against an excessively authoritarian father. The mother-ridden girls seem to be motivated by feelings of both love for and revenge against their own mothers, and they often want their mothers to adopt the child. The father-ridden appear to act from hatred against their fathers and often against all men, and they usually express violent hate and jealousy of their own father and the father of their chid.

Much illegitimacy is, of course, not of this unconsciously motivated type. Among many Negro and some white groups, for example, pregnancy and childbirth are naturally expected conditions of life whether in or outside marriage. Then, too, many out of wedlock children are definitely not desired, and they are the result of emotional misadventure and failure of contraception.

It appears that a considerable number of illegitimate children are reared within the maternal family either by the mother or by the mother's mother, and the remainder, probably a minority among non whites and a majority among whites, are given by adoption through a social agency to an unknown outsider. Although illegitimacy is certainly "a social problem" with its concomitants of heartaches and headaches for most of those involved, there is a silver lining even to this dark cloud. In the first place, an illegitimate child is sometimes a source of greater joy than sorrow to its mother and her family. Even more significant is the fact that illegitimate

births are the source of adopted babies. Over one in ten of all marriages are involuntarily childless. Since most of these couples desire to adopt a baby, illegitimacy is a blessing to these childless couples. Curiously enough, from their standpoint there are not enough illegitimate births because most of these couples must wait one, two, three, or more years in order to adopt a baby, and some are never able to have one because there is not enough for all who want them.

There are no indications that the number of illegitimate births will materially decrease in the immediate future. Even the perfection of better contraceptive devices and the increased knowledge of their use may have only a slight effect upon this phenomenon. Over a long period of time, however, a decline may be experienced for two other reasons. Better education and economic conditions among Negroes in the south and the consequent changes in their social and family relations would seem to stimulate an increase in statutory marriages and hence a decrease in illegitimacy. Improved mental hygiene measures in the home and school should help to decrease the strong unconscious motivation towards out of wedlock pregnancies especially among whites. In the meantime, a clearer understanding of the scope and nature of illegitimacy will help social agencies, religious organizations, clinicians, and families to deal more realistically and humanely with this problem.

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BOOK REVIEWS

TRENDS AND DIFFERENTIALS IN MORTALITY: PROCEEDINGS OF 1955 ANNUAL CONFERENCE OF MILLBANK MEMORIAL FUND. New York, 1956

The issuance this year of "Trends and Differentials in Mortality" brings a welcome addition to the publications of the Millbank Memorial Fund on the dynamics of population change. To a major extent past volumes and articles in this subject matter area have been concerned with fertility. The current volume serves to balance the demographic picture by concentrating on the equally important and exciting developments in mortality.

"Trends and Differentials in Mortality" is a collection of the papers and comments by scheduled discussants presented at the 1955 Annual Conference of the Millbank Memorial Fund. The conference was organized as "round table" sessions with a limited number of participants, all of whom have made important contributions in this field. They were given as their material a series of highly informative and thought provoking articles. The reader will likewise find them so, but an element is missing for the non-participant: the cross-discussion that must have taken place at the conference. Incorporation of such comments would have added appreciably to the value of the volume. It is realized, however, that technical problems may have made this difficult to accomplish.

The first section in the volume presents three highly integrated papers on mortality trends in underdeveloped areas. Through mortality indices derived from data published in the Statistical Yearbook of the League of Nations and the United Nations Demographic Yearbook, Drs. Jean Bourgois-Pichat and Chia-Lin Pan of the Population Branch, United Nations, draw far-reaching conclusions about the course of mortality in underdeveloped areas.[1] The authors conclude that whereas prior to World War II the downward trends were gradual, after the war the decline accelerated at an unprecedented rate in a number of the underdeveloped areas, further the potential for large declines in other areas is high. The dominant influence in these declines is the development of public health programs accompanied by the wide use of new drugs, rather than a rise in the level of living of the people.

This thesis is supported in the paper by Dr. George J. Stolnitz of the Office of Population Research, Princeton University.[2] Through a comparative study of mortality trends, it is found that recent rates of decline in underdeveloped areas have no substantial parallel in Western experience. One significant point of similarity between the periods of great mortality movements in Western nations and in underdeveloped areas is that they have been initiated by major strides in medicine. Stolnitz concludes that further declines in areas that have experienced sharp decreases will be dependent on the slower moving forces of economic and social change.

The final paper of the session deals with the critical question of how permanent the recent declines in mortality previously discussed are likely to be. Dr. Marshall C. Balfour of the Rockefeller Foundation points to the fact that acquired resistance in the human to antibiotics and in insects to specific chemicals requires a continuous research program and new pharmaceutical and biological weapons if recorded advances are to be maintained.[3] Dr. Balfour takes an optimistic view of the future both for medical advances and for the emergence of those economic, social, and psychological changes necessary to achieve and sustain low mortality in the underdeveloped areas.

Dr. John E. Gordon of Harvard University School of Public Health, in discussing this paper also expresses optimism about the immediate future, but has reservations about long-term behavior because of the unpredictability of social forces which influence mortality. Dr. Gordon, in addition, draws attention to the need for placing greater emphasis on environmental sanitation and on the organization of permanent and strong public health programs in areas where antibiotics and insecticides have produced spectacular results.

The second set of papers is concerned with

[1]Pichat-Bourgois, Jean and Pan, Chia-lin *Trends and Determinants of Mortality in Underdeveloped Areas.*

[2]Stolnitz, George J., *Comparison Between Some Recent Mortality Trends in Underdeveloped Areas and Historical Trends in the West.*

[3]Balfour, Marshall C., *Some Considerations Regarding the Permanence of Recent Declines in Mortality in Underdeveloped Areas.*

trends and differentials in mortality in highly developed countries where mortality has been comparatively low for a long time. In the initial paper, Mortimer Spiegelman of the Metropolitan Life Insurance Company surveys the changes that have occurred in the mortality of these countries.[4] A clear picture emerges, thereby, of the differences between the issues that face underdeveloped areas and those that dominate the thinking in highly developed countries. Many of the infectious diseases which are the killers in early and mid-years of life have been brought under certain control in the latter countries. Further reductions in mortality are dependent on the solution of complex problems related to the etiology of chronic diseases typical of the later years in life and to the prevention and treatment of these conditions. Morbidity and mortality statistics have already provided leads for attacking these problems but there is a need for more extensive information about the influence of environmental, cultural and demographic factors, family history, and medical care on specific chronic diseases. This conclusion provides the setting for the papers that follow.

Preliminary results of an investigation of occupational and social class differences in mortality among males aged 20—64 years are given in the paper by Dr. I. M. Moriyama and Lillian Guralnick of the National Office of Vital Statistics.[5] The study is based on entries on the official death certificates of the United States for 1950. Through age comparisons among six broad occupational groupings, the authors find that at the younger ages death rates generally increase as occupation level declines, but that after age 45 the mortality curves overlap considerably for all groups except laborers (the lowest socio-economic category among non-farm workers). The rates for laborers are far higher than for any other group, including agricultural workers. Comparisons are made with rate differentials among socio-economic classes in England and Wales, with the finding that the gap is narrower in England and Wales. The paper is an auspicious introduction to the extensive body of data relating occupation to mortality which will become available in the not too distant future.

Illustrative of the epidemiological approach being taken in studying morbidity and mortality in highly developed countries is the article on cancer by Dr. Harold F. Dorn of the National Institutes of Health, United States Public Health Service.[6] This paper demonstrates the important contribution that studies of age, sex and race differentials and trends can make to the development of hypotheses about the etiology of some of the chronic diseases. For example, sex differentials in cancer morbidity have suggested that exposure to sunlight and other elements of the weather is one of the explanations of male-female variations in cancer of the head, face, neck, and other extremities; also, the upward trend among white males in mortality from lung cancer has focused attention on smoking, air pollution, and occupational or industrial hazards. A generalized inference drawn from the variations in morbidity and mortality rates is that cancer is not a single disease but that specific etiological agents exist whose effects are highly localized.

Some of the factors that must be considered in trying to evaluate cancer mortality trends for clues to causation are discussed by Dr. E. Cuyler Hammond of the American Society for Cancer in commenting on Dr. Dorn's paper. These include improvement in diagnosis, increased cure rates, changes in the environment, and the possibility that decreases in deaths from other causes result in a proportionate increase in people who are more susceptible to cancer. Trend mortality data for specific sites are drawn upon to illustrate the significance of these factors and the need for more knowledge about them.

The paper "Mortality Among Impaired Lives" by Herbert H. Marks of the Metropolitan Life Insurance Company is a concise statement of basic issues involved in statistical studies of this subject. The definition of impairment materially affects the range of conditions classified as such and specific criteria and methods of collecting data must be taken into account to interpret correctly available statistics on impairment. Mr. Marks reviews the variety of sources that exist for developing these statistics, the advantages and limitations of each, the kinds of impairments included, and results from a few of the numerous studies that have been conducted. Among the more extensively used sources are life insurance records which are the basis for the comprehensive "1951 Impairment Study," and hospital, physician, and clinic records which provide material for long term studies of specific chronic diseases. The listing of references appended to

[4]Spiegelman, Mortimer, *Recent Trends and Determinants of Mortality in Highly Developed Countries.*

[5]Moriyama, I. M. and Guralnick, L., *Occupational and Social Class Differences in Mortality.*

[6]Dorn, Harold, F., *Ecological Factors in Morbidity and Mortality from Cancer.*

the article is a highly useful guide to major sources of material on the subject.

The third section of the volume presents three papers on research in mortality. In the first of these articles, Dr. Ansley J. Coale of the Office of Population Research, Princeton University, examines "The Effect of Declines in Mortality on Age Distribution." It is shown that improvement in mortality need not necessarily result in an increase in the average age of population. Two factors determine the direction of changes in the age distribution—the age at which the probability of surviving is most improved and the course of the fertility rate. Dr. Coale observes that in countries where infant and childhood mortality dropped sharply between 1900 and 1940, the median age of the population would have been lowered if fertility had not declined. Today, improvement in mortality at ages above 50 is a dominant factor in these countries, and the effect of this improvement on the future aging of the population will be more pronounced than ever.

In his article, "Standard Age and Sex Patterns of Mortality," Dr. Vasilios G. Valaoras of the Population Branch, United Nations, develops model life-table mortality rates which could be used in estimating average levels of mortality for countries and periods with scanty mortality data. Through an examination of a large body of national life tables covering a wide geographic area and what is believed to be nearly the entire range of mortality levels, he concludes that there is a consistent relationship in the mortality rates for successive age groups at all levels of general mortality. By fitting second degree parabolas to ${}_5q_x$ values for each pair of successive age groups taken from 158 available life tables, 40 series of theoretical expectations of life at age zero and mortality rates are derived. These data are presented for males and females.

One of the phenomena of modern life in the United States and other countries with comparatively low mortality is the increasing advantage in expectation of life that women have over men. Dr. Rupert B. Vance and Father Francis C. Madigan of the Institute of Research in Social Science, University of North Carolina, present a unique research design for investigating the possible influence on differential mortality between males and females, that is exerted by their distinctly different social roles and functions, and "styles of life."[7] To be studied are the lifetime and mortality records of certain American-Catholic religious Brothers and Sisters who follow the same occupation, have common religious interests and customs, are free of financial worries, practice celibacy, and in other ways can be considered to follow the same regime of life. The authors characterize the study as a controlled experiment; the subjects are the Brothers and Sisters; the controls are the white population of the United States living during the same time period as the subjects.

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World Population and Resources: PEP (Political and Economic Planning), 16 Queen Anne's Gate, London, S.W. 1, and Essential Books, Inc. Fair Lawn, New Jersey, 1956, 339 pp. $4.80.

This is unquestionably the best book addressed to the intelligent public combining a treatment of world population data with consideration of population policy and its implementation which has yet appeared. It is "best" in several respects: in the amount, relevance and validity of the data which it presents; in the comprehensive and objective character of its consideration of population problems of nations in various stages of development; in the sobriety and sanity of its recommendations and conclusions; and in its well-organized, competent and readable treatment of a complex, technical and controversial field.

The book is divided into four parts. Part I "World Population and Resources" is an admirable summary of available information on world population growth, and on agricultural, mineral and energy resources; and contains a balanced consideration of population pressure and economic development. Part II "Nineteen Countries and Islands" is a highly condensed and effective treatment of 19 case studies in seven categories: a primitive community, densely populated small islands, under-developed and densely populated countries, under-developed and thinly populated countries, developed and densely populated countries, developed and thinly populated countries, and a country with a declining population. Part III "Nation and Family" sets forth major problems of policy utilizing the actual experience of six nations under three headings "expansionist" (France, USSR), "restrictive" (India, Japan) and "stabilization" (Sweden, United Kingdom) and discusses, perhaps too briefly, migration, religious views, birth control methods and eugenics as

[7]Vance, Rupert B. and Madigan, Francis C., *Differential Mortality and the "Style of Life" of Men and Women: A Research Design.*

factors in population policy. Part IV is devoted to "Discussion, Recommendations and Conclusions."

The Report also contains three short technical appendices and a highly useful 22 page "Summary" which, when taken together with the 12 pages of "Recommendations" and "Conclusions" in Part IV, may be read by the busy reader as an effective statement of the essence of the Report. But to restrict oneself to these portions of the book would be to miss much in the way of data, organization and analysis which not only is an admirable publicization of what is already known to the demographer but also, at a number of points, represents distinctive contribution to scholarship.

While treating of the population problems of the more economically advanced nations, the major focus of the Report, and appropriately so, is on the problems of the less developed areas of the world. Most of its recommendations and conclusions are addressed to the problems of such areas which are now, or which will soon be, faced with rapid population growth as a barrier to efforts to raise levels of living by means of economic development programs. A major contribution of the Report, nevertheless, lies in its explicit treatment of population problems, not as a unitary global problem, but as a multiplicity of problems calling for specific and diverse policies and action programs. It is recognized that "population policies with opposite aims are in future likely to be needed and pursued by countries at different stages of the population cycle." (xxxiv) A global conclusion which inevitably emerges, however, is explicitly stated as follows: "in future, death-control should not be stressed on in isolation but should go hand in hand with birth-control." (p. 319)

PEP's recommendations are listed under two headings "Research" and "Action." The former contains eight specific items, and first of which joins others in pressing for "research into human fertility and methods of regulating it." (p. 324) Recognition of the need to extend our knowledge of human reproduction and ways of controlling it is combined with recognition of the needs for research into other aspects of population change, including the psychological, sociological, ecological, economic, nutritional and health. Nine specific items are listed under "Action" recommendations, including suggestions for explicitly recognizing and taking into account population growth in planning economic development; and provision, when acceptable to the governments concerned, for birth-control advisors on medical teams in under-developed countries. PEP presents its recommendations with appropriate humility and qualification: "The recommendations . . . . do not purport to solve the problem of world population and resources. No panacea or comprehensive solution is yet in view. . . . There is no sovereign remedy, no short cut and above all no quick answer." (p. 323)

The Report frontally and objectively deals with such issues as conflicting Communist and Western ideologies, moral and religious aspects of sex and birth control, and the relation of population problems to world peace or war. It manages to steer down the middle road between optimism and pessimism in respect to subjects which have all too frequently been treated in an alarmist and emotional way—such as, the conservation of resources, eugenics (including the influence of heredity and environment), and the future outlook.

The Report, of course, will not please all readers in all respects. It will undoubtedly be found wanting by some specialists. For example, many of the readers of this journal will probably wish more attention had been devoted to eugenics; economists will probably want more space devoted to the relation between population factors and economic development; the political scientists will in all likelihood prefer a fuller discussion of population in relation to world politics; the sociologist and psychologist will note the relatively scant attention to social psychological factors in respect of population problems.

Nevertheless, the work is one of good balance and rounded perspective. The anonymous authors of the Report, a "distinguished group of natural and social scientists" (jacket) whose work was made possible by grants from the Eugenics Society and the Nuffield Foundation, merit high commendation for a scholarly, significant, and readable contribution to an understanding of an important aspect of the contemporary scene. PEP by adding this Report to its already imposing list will further enhance its reputation for contributing both knowledge and wisdom towards the solution of urgent national and world problems.

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Life Tables from Limited Data: George J. Stolnitz, Office of Population Research, Princeton University, 1956, 164 pp., $4.00.

This book presents a method of estimating survival rates and values of life expectation

from a single census count or probability sample, classified by age, and from limited amounts of supplementary information. The method should prove very useful to students of population in cases where mortality data are nonexistent or too inaccurate to use in preparing life tables by conventional techniques. Such cases would include subgroups of national populations for which census data but no vital statistics are available, historical studies of periods in countries like the United States, where censuses were taken for many years before death registration was well established, and many economically underdeveloped countries, where the method will probably be most frequently applied. The author has used data from a large number of countries and from long time series in the development of the method and in proposing ways of estimating the parameters of the survival rates. In no sense, then, is the method limited for use in particular countries or particular historical periods. In addition to his description of the method, Stolnitz presents four original life tables: one for each sex for the native white population of the United States, 1885-1889, and one for each sex for the native population of Brazil, 1936-1940.

Stolnitz' single-census method of estimating the life table survival rate (${}_np_x = l_{x+n} \div l_x$) consists of computing ratios of observed numbers of persons in adjacent age groups and then modifying these ratios to eliminate the influence of past variations in numbers of births and migrants and past differences in mortality since birth. After the survival rates are computed, they are adjusted for the more obvious anomalies and smoothed by conventional techniques. Stolnitz wisely limits the survival rates derived from the single-census method to those that can be estimated for ages between 2.5 years and an unspecified upper age (67.5 is indicated as a likely upper limit for many populations). Other methods are proposed for estimating survival rates outside this broad range.

The basic equations on which the single-census method depends can conveniently be described by example. Suppose that we are given a census count of a "closed" population (*i.e.*, one unaffected by migration) for January 1, 1950, and suppose that we want to estimate the probability of surviving from the age group 20-24 years to the age group 25-29 years in the period 1945-1949. We can consider the younger age group as the product of two components, as follows:

population 20-24, 1950 = (births, 1925-29)
× (survival rate from 1925-29 births to ages 20-24)

The older age group can be considered as the product of three components:

population 25-29, 1950 = (births, 1920-24)
× (survival rate from 1920-24 births to ages 20-24)
× (survival rate from ages 20-24 to ages 25-29)

The ratio of the older to the younger age group in 1950 can, therefore, be considered as the product of three components, as follows:

$$\frac{\text{population 25-29, 1950}}{\text{population 20-24, 1950}} = \frac{\text{births, 1920-24}}{\text{births, 1925-29}} \times \frac{\text{survival rate, 1920-24 births to ages 20-24}}{\text{survival rate, 1925-29 births to ages 20-24}} \times \text{survival rate, ages 20-24 to ages 25-29}$$

Stolnitz calls the ratio on the left of the above equation the "population ratio," the first ratio on the right, the "birth ratio," and the second ratio on the right, the "survival ratio." The survival rate can, then, be estimated from the following equation:

$$\text{survival rate} = \frac{\text{population ratio}}{(\text{birth ratio}) \times (\text{survival ratio})}$$

In the example cited, Stolnitz would allow this survival rate, which is the proportion surviving from ages 20-24 to ages 25-29, to represent the survival rate between exact ages 22.5 and 27.5, or ${}_5p_{22.5}$. The underlying assumption, that survival rates for whole age groups are equal to survival rates for midpoints of age groups, is discussed in detail and shown to be valid for all practical purposes. (Correction factors are proposed for estimating ${}_5p_{22.5}$ from the above formula.)

The advantages of expressing the survival rate in terms of ratios is that reasonably accurate ratios between absolute values are more easily estimated than are the absolute values themselves. Therefore, it is not necessary, although it may be desirable, to have past series of births from which to derive the birth ratios or past series of death rates from which to derive the survival ratios. Values for these ratios can be estimated from observed variations in neighboring or similar countries, or reasonable guesses can be made on the basis of the timing of particular events in the past, such as wars and epidemics. The author suggests several ways of estimating the birth and survival ratios in situations where data on past births and deaths are entirely lacking. In addition, a great deal of international data on observed variations in these ratios are summarized to serve as useful guides.

It should be noted that Stolnitz' method is not restricted to data classified by five-year age groups. It can also be applied to single-year age groups, ten-year age groups, and even to distributions combining several different age intervals.

In the chapter immediately following the exposition of the single-census method, Stolnitz treats in detail the problem of adjusting observed age distributions for the influence of migration. In the next chapter he cites a wide range of data that can be used to test and correct the internal consistency of the survival rates obtained by the single-census method. Included are observed differences between age-specific survival rates by sex and observed differences between survival rates for adjacent age groups. In addition, the relationship between errors in estimated survival rates and errors in values of life expectancy derived from these estimates is discussed. In the remainder of the book, the author presents the results of tests of the single-census method, the four original life tables for the United States and Brazil mentioned previously, and a survey of the uses for which the single-census method may be appropriate.

The accuracy of the survival rates and values of life expectancy estimated with the use of the single-census method depends largely on the quality of the age enumeration and on the amount and accuracy of the additional information available to estimate survival ratios, birth ratios, and adjustments for migration. There will, therefore, be cases in which the amount and quality of the basic data will not be sufficient to yield useful results. The tests to which Stolnitz subjected the single-census method indicate, however, that even when the basic data are very limited and somewhat deficient in quality, life-table functions can be estimated that are adequate for many purposes. For example, they would be useful for obtaining estimates of expected numbers of years of life spent in the labor force, making population estimates and projections on the assumption of constant mortality, computing net reproduction rates, and comparing levels of mortality for broad age groups. The accuracy of the results of the single-census method will also depend on the ability of the technician to correct the basic age distribution for reporting biases and to estimate past trends in births, deaths, and migration from incomplete data and scattered quantitative hints. By its very nature, the single-census method is one that will yield the best results in the hands of persons well trained in estimating techniques.

Although it may happen, in a particular application of the single-census method, that none of the estimated survival rates are so inaccurate as to be unacceptable, Stolnitz notes that some of the age-specific death rates implied by these measures may contain large percentage errors, particularly for age groups having low mortality. Thus, for example, the difference between a correct survival rate ($_np_x$) of .99 and an estimated survival rate of .98 is only 1 per cent, but the estimated death rate of .02 ($_nq_x = 1 - {}_np_x$) is 100 per cent above the correct death rate of .01. However, no method of estimating life-table functions that is not dependent on highly accurate mortality and population data can be expected to yield accurate death rates for the low-mortality age groups. The inability of the single-census method to provide such estimates by no means destroys its general usefulness, even in making broad mortality comparisons.

Stolnitz' single-census method of estimating life-table functions represents a valuable contribution to the methodology of population analysis. The usefulness of the method is enhanced by its appearance during a period when adequate censuses are being taken for the first time in many countries. It is reasonable to expect that population studies will play an important role in the development of plans for economic and social progress in these countries, and that the single-census method will increase the scope and value of such studies.

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ELEMENTS OF GENETICS: Mendel's Laws of Heredity with Special Application to Man. Edward C. Colin, McGraw-Hill, New York, 1956, ed. 3, 498 pp. $5.75.

This is an excellent introductory textbook on genetics that contains sufficient factual material to be adapted to a wide range of teaching goals. Some issues, such as the nature of the gene, are perhaps over-simplified. The section on natural selection uses the old and misleading phrases, "struggle for existence" and "survival of the fittest" in paragraph headings, and the use of obsolete pedigree symbols throughout the book is unfortunate. In general, however, accuracy is high, and the two long chapters on "Heredity in Man" provide a more satisfactory catalogue of human traits than the reviewer has seen in any other college text.

Since this is a McGraw-Hill textbook of high

standards and a third edition, one can safely conclude that it will be read by a large number of college students. Of special interest, therefore, is the chapter on eugenics. This is only fifteen pages long but covers the most important aspects of the subject. The author does not imply any urgency about eugenics, nor does he attempt to predict how soon or how successfully eugenic measures may attain specific goals, but he is clearly sympathetic with the objectives. His point of view is summarized by the following extracts:

"In view of the complex nature of man, as well as his heterozygous constitution, we should expect to see many mediocre and defective children produced by superior parents. . . . Conversely, and for similar reasons, we should not be surprised to see many superior individuals produced by mediocre parents. . . . Nevertheless, superior parents have a better chance of producing superior children than do mediocre or defective parents. A steady increase in the number of children from the better-adapted parents should result in a gradual rise in the average quality of the population."

The author makes one point that has received little emphasis from eugenists: In any plan to increase the fitness of the organism, whether it be a plant, a domesticated animal, or man, due regard must be had to the environment in which the organism is to live. . . . Unless the environment is made as nearly optimum as possible for all the people, we are not giving all of the genetically superior individuals an opportunity to express themselves."

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SOCIOLOGY AND THE FIELD OF MENTAL HEALTH: John A. Clausen, Russell Sage Foundation, New York, 1956, 62 pp., $.50.

The stated purpose of this small volume is to "delineate some of the present and potential contributions of social science . . . in the mental health field," and to "focus on social science areas related to mental health and report upon recent literature . . . in an effort to illustrate types of approach rather than assess the body of accumulated knowledge."

After a brief review of the epidemiological background factors of mental illness in the United States, *i.e.*, under-staffed and overcrowded conditions in mental hospitals and the scarcity of funds for basic research in this important area, the author discusses mental health and illness in the cultural perspective. Emphasis is placed on the confused orientation of the public, and the ill-defined and naive concepts held by the majority regarding the recognition and care of mental illness. The confusion of the layman is, at least in part, regarded as a reflection of the fact that scientific workers disagree on the criteria for defining mental health. Some controversial concepts are noted, and attention is called to the fact that even in large cities with good facilities, people tend to isolate and deny the existence of mental problems within their families until stresses become intolerable.

In the following four chapters, the author defines the greatest area for sociological contribution as being "from research and development of the body of sociological and social psychological theory regarding the relationship of an individual to his social milieu." Within this definition the various research approaches are discussed, including (a) the study of personality development in the family and society, (b) epidemiological studies which assess the incidence of mental disorders in various segments of the population, and (c) the study of differing social experiences with respect to, and of different symptomological manifestations of, mental illness in various cultures. Also within the realm of sociological research are believed to be those studies dealing with the influence of the social structure of treatment settings on their therapeutic function. The need for research here has been focused upon by the recent recognition that the matrix of a patient's social relationships, both in and out of the hospital, and the orientation of the clinical staff toward his problem play a significant part in his recovery. Further discussed are the roles played by sociologists in assessing community needs for mental health facilities, and the manner in which mental illness affects intra-family and communal relationships of the patient.

In addition, the recent contributions of sociology to the mental health field are listed with the aid of a careful bibliography (98 references), although the emphasis is placed on methodology rather than an evaluation of results.

The last chapters are devoted to a discussion of the role of sociologists as participants in mental health programs and of the problems arising in inter-disciplinary collaboration. The need for further sociological research is stressed, although the author believes that "few sociologists have felt entirely comfortable in attempting to put their knowledge of human organ-

ization to direct use in operating programs. Frequently, indeed, efforts to do so have made them acutely aware of the fact that their theoretical knowledge . . . has not been adequate for immediate direct use."

Inasmuch as "no discipline has a corner on the (mental health) market," the author pleads for multi-disciplinary research, repeatedly stressing his belief that with a core of common goals and with a mutual awareness of the prerequisites for productive collaboration (flexibility and tolerance for another worker's discipline) satisfactory working relationships can be worked out.

Throughout this carefully prepared and realistically formulated volume runs the plea, sometimes subtle and sometimes direct, that sociologists avail themselves of the opportunities to expand our body of knowledge through inter-disciplinary collaborative efforts. The hope is expressed that this plea, so well-founded and accurately stated, will not be ignored.

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RACES AND PEOPLE: William C. Boyd and Isaac Asimov. Abelard-Schuman, New York, 1955, 189 pp., $2.75.

This little book is an excellent introduction to physical anthropology and population genetics. It covers a great many technical topics with clarity and penetration.

Titles of the ten chapters (and some of their subdivisions) follow: (1) The Mystic Word "Race;" (2) What Races are Not (National Characteristics, Language Families); (3) Skin and Bones (Skin, Hair, Eyes, Bones, Heads); (4) Through The Microscope; (5) From Parent to Child (The Egg Cell and The Sperm Cell, Fertilization, Variation Among The Genes); (6) The Rules of Inheritance (Mendel and His Peas, The Odds of Three to One, The Disadvantage of Small Numbers, Genes in the Plural, The Y-Chromosome Again); (7) Rules Can Be Broken (Locating the Gene, The Outside Influences, The Sudden Change); (8) The Telltale Blood (Race by Way of Genes, The Differences in Blood, The ABO Blood Groups, Other Blood Groups); (9) Races At Last (Advantages of the Blood Groups, The Key Word *Frequency*, Mapping the World by Genes, The Human Races by Genes); (10) The Present and Future of Race (What About Racism? What About the Future? The Improvement of Man).

The authors' six "genetic races" of man (page 158) are:

Australian aborigine—low B or none, low M, no A_2.
American Indian—low B or none, low N, no A_2.
Asian—high B, high Rh^s, no A_2.
African—high B, high Rh^o, some rh, high A_2.
European—moderately high rh, moderate B, moderate A_2.
Early European (Basque)—very high rh, no B.

Classical genetics is illustrated largely with examples from human material. The concept of race is based largely on blood group data. Controversial subjects such as race superiority, eugenics, the effects of atomic radiation and of the relaxation of natural selection on future human populations are treated in a manner which should please students of human evolution. Thus the question of "improving humanity by deciding who ought to have children and who ought not" is answered by stating that it is first "necessary for us to learn a great deal more about genetics. That is the important thing, knowledge and more knowledge . . ." (page 173).

There are five sketch maps, 21 diagrams and an index. The book merits wide circulation, and its reading will reward devotees no less than novices.

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GENETICS IN THE ATOMIC AGE: Charlotte Auerback (Institute for Animal Genetics, University of Edinburgh). Essential Books, Ins. 1956, 101 pp., $2.00.

This is a brief but clear warning of the harmful effects of ionizing radiation on the germ plasm of living things, particularly man. It offers no solution to the problem of X-rays and various atomic phenomena but explains the premises and considerations which must underlie any solution.

Mutation, heredity and selection—what they are and how they produce evolutionary changes in populations—are presented in seven short chapters as background for two final chapters: The Production of Mutations by X-Rays, and The "Genetically Permissible" Dose of Radiation. While the book is designed for readers without scientific background, the finale will be found interesting to all students of human evolution and genetics.

The effects of ionizing radiation on cell nuclei are classified as gene mutations and chromosomal breaks. Their frequencies are directly proportional to the amount of the radiation dosage, down to the smallest quantity, regardless of whether it be applied in a short and heavy or a long and light exposure, or in several installments. This simple rule of proportionality does not apply, however, to translocations or other rearrangements of chromosome fragments following a multiple break, since these depend more on chance. Four types of gene mutations are described, in order of ascending frequency: (a) dominant lethals (b) recessives with visible effects (c) recessive lethals, and (d) recessive harmful genes without visible effect. In Drosophila the relative frequency of each type is roughly four times as great as that of the preceding type, and there is no reason to suppose that these proportions are very different in man.

All but the minutest proportion of gene mutations produce effects which are harmful, but they are removed from the population sooner or later by natural selection. Those which produce greater degrees of harm disappear in relatively few generations and those producing less harm diminish in frequency more gradually, the recessives of course lingering for more generations than the so-called dominants (heterozgotes which manifest the trait). Among mammals, radiation causes additional harm by temporarily reducing fertility and by damaging the developing embryo or fetus of pregnant females.

The "burden" (harmfulness to a population) of genetically induced diseases, deficiencies and abnormalities cannot be avoided. Some are less painful than others, however. Thus "dominant lethals generally kill the embryo at a very early age," and "we expect visible mutations of, say, the skeleton or the nervous system to produce similar results." Such mutations cause the least harm, and in the human species are often undetected or perhaps noted merely as a missed menstrual period. The harm occasioned by a recessive trait may be deferred for many generations, in reverse proportion to the frequency of the gene which produces it. The burden of less severe manifestations is shared by several generations: a gene which curtails reproduction without preventing it entirely may be said to occasion only a fraction of a "genetic death" in each zygote in which it appears, thereby reducing the frequency of the provocative gene gradually towards the vanishing point as the generations pass.

Certain hereditary diseases and disabilities are amenable to medical therapy. This situation leads to the controversial question of the accumulation of "deleterious" genes which can be expected to result from improved medical methods. The author points out that this accumulation can be reduced in the last resort only by genetic deaths.

The argument that ionizing radiation has no other effect on human evolution than speeding it up, since it produces beneficial mutations as well as harmful ones and in the long run is neither good nor bad but merely accelerates the processes of nature, is countered as follows (page 101): "In nature, good mutations can spread through a species because their carriers leave more offspring than the average, and bad ones are eliminated through the death or infertility of their carriers. Neither process is likely to be effective in our own species, in which family size is kept low, superior mutants are not likely to have larger families than the average, and physically and mentally weak mutants are not generally eliminated by natural selection. To think that mankind might be improved by a speeding-up of the mutation rate is based on a misconception."

The book contains 46 illustrations and a helpful glossary of scientific terms. As H. J. Muller has said, it makes clear "why the use of atomic energy requires the most scrupulous protective measures if future generations are not to pay the cost."

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EDUCATION FOR MARRIAGE: James A. Peterson. Charles Scribner's Sons, New York, 1956, 429 pp. $5.50.

With a number of books already available for the college student on marriage preparation, the appearance of a new manual elicits the question, "What is the justification for this one?"

The primary answer appears to be that Dr. Peterson, sociologist and marriage counselor, takes the verbiage about emotional learning one step further than have most writers. At the end of a number of chapters the author offers a series of questions as an aid to self-analysis. There are, for example, questions for the student to answer on his family background, social and neighborhood influences, psychosexual development, mood reactions, dating behavior, woman's role, recreational interests, religious participation, and socio-economic expectations. The function of these suggested explorations into the student's own history is, according to the author, the following: "by

enabling him to analyze his own background, it may assist him to eliminate inhibitions, clarify his sense of his role, and grow in his ability to adjust to others—and to that extent help him to determine his own marital destiny rather than act the part of a puppet manipulated by strings attached to his past and to his culture."

The goal is a laudable one, and the author would probably be one of the first to admit that self-analysis through the answering of such questions may not always be possible or, if possible, not always effective. There can be, on the other hand, no doubt that the answers to the suggested questions are pertinent to individual self-awareness, as well as within the purview of current orientations in the social and psychonalytic sciences. By applying these perspectives directly to the scope of his own life, the learning experience may become functional for the individual reader.

In carrying out this avowed purpose, however, the author poses some of the questions in such a manner that, if the student really knew the answers, the question need not be raised and—if asked—could not be answered. For example, "What is your pattern of dating?" "Analyze any conflicts in values you had with your parents." As Dr. Peterson is no doubt aware, human memory can be a very selective thing. And, to make an analysis effective, there has to be some basis for comparison. Even a check list of the possible scope of various areas of response might aid in giving some perspective, as well as serve as an aid in covering relevant ground. The realistic assessment of potentialities for personal growth through the use of such questions in the usual context of the marriage course is one which still is in need of empirical verification, as the author notes in a section on "Trends in Family Life Education" in the appendix.

There remains the reticence of some professionals toward any suggestion for emotional learning when its boundaries lie outside actual therapy. This group rejects any action that holds the potential of pain for the novitiate unless there is a competently trained aid nearby to come to the rescue. For these, there can be no assurance that any question may not be threatening for some persons. Others would answer that it is only through the raising of painful questions and facing them that personal growth is most likely to take place. The statement of a psychiatrist in the forward of the book is another point of view: "If the suggestions for self-analysis only raised questions and doubts without pointing to a solution, they would still serve their purpose of increasing awareness of the various aspects of interpersonal adjustment that need to be evaluated before marriage is decided upon."

Organized within a section on "Preparing for Marriage," the first chapter of the book deals briefly with the historical changes in marriage form and function. A chapter on factors in childhood is in accord with current consensus on the importance of the family, defined mainly in terms of the mother and secondly in terms of the father. Lacking is consideration of the influence of siblings and peers, whose empirical study is lacking generally. The growth of independence and sex identification is covered in a chapter on adolescence, but vocational choice is ignored. Chapters on the psychological, socio-cultural, and economic factors complete about half of the book. The remaining portion is devoted to "Preparation for Marriage" through counseling, temperament tests, and a physical examination. "Achievement of Togetherness" is the fourth and last section and is developed through consideration of such topics as religion, sexual maturity, economic planning, recreation, planning for children, and even through conflict. Throughout the text there are appropriate references to empirical studies and to case histories from the author's files.

The student is thus faced with looking at what may be his current concern about selection of a marriage partner not solely in terms of the present but also within the framework of his entire life history. The author is rightfully saying that marriage preparation is preparation for life, and its beginnings are the very beginnings of life. In this, Dr. Peterson is making another contribution pointing in the direction of the assimilation of a scientific perspective to an ever-widening audience.

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PERIODICAL ABSTRACTS

GENETICS

Congenital galactosemia, a single enzymatic block in galactose metabolism. K. J. Isselbacher, *et al., Science 123* (1956), pp. 635-6.

Galactose, a sugar derived from milk, is normally utilized in a four-step conversion to glucose, mediated by four enzymes. Some infants have a hereditary absence of the enzyme required for the second step, but it was hitherto impossible to tell whether the defect extended to the enzyme of the third step. The authors found that this enzyme could be demonstrated in both normal and galactosemic blood cells after the addition of a well-known coenzyme, DPN.

The hypothesis of a one-to-one relationship between genes and enzymes is useful and at least approximately correct. Galactosemia is one among several examples from human genetics where a gene mutation has been shown to affect a single enzyme. The possibility remains that the gene may have undetected effects on other enzymes, and it is almost certain that other genes may directly or indirectly influence the enzyme involved in galactosemia.

The measurement of natural selection. J. B. S. Haldane, *Proceedings of the 9th International Congress of Genetics* (*Caryologia* Vol. 6, Supp., 1954), pp. 480-487.

Intensity of natural selection during the individual life span is usually easy to study with respect to any well-defined trait. One need know only the distribution of the trait in the population at the beginning and end of the period of life in which selection is being studied. The author suggests a logarithmic expression to measure the intensity of such selection.

As one of several examples, the author analyzes data on birth weight and survival of 6,693 female babies during the first 28 days of life. Of all deaths in that period, 58 per cent were selective with respect to birth weight; that is, mortality would have been less than half as great if all babies had had the optimal birth weight. As in this instance, the optimum is usually near the mean, and most natural selection is therefore stabilizing in its effect and eliminates the extreme variants. The survivors, since they are between the possible extremes, are probably heterozygous or more "hybrid" than those eliminated. However, much natural selection may be purely phenotypic, without relation to genetic factors.

Hereditary leptocytosis (thalassemia minor). D. G. Hanlon, *et al., Journal of the American Medical Association* 161 (1956), pp. 1132-1135.

It is important for physicians to recognize the heterozygous or carrier state of Mediterranean anemia and to distinguish it from iron deficiency anemia. While the latter condition should be treated and is sometimes an indication of more severe disease, thalassemia minor does not impair health and cannot be corrected by medical means. The atuhors report two cases in which correct diagnosis at the start would have saved the patients much concern and expense. The most useful criterion for distinguishing thalassemia minor from iron deficiency anemia or chronic blood loss is the high red blood cell count. Also helpful is the fact that the trait is generally found in people of Mediterranean descent.

Fibrocystic disease of the pancreas, a generalized disease of exocrine glands. P. A. di Sant'Agnese, *Journal of the American Medical Association* 160 (1956), pp. 846-853.

Fibrocystic disease of the pancreas is now recognized as a very complex and variable hereditary disease. In extreme cases it causes death in the newborn period from intestinal obstruction, while there may be mild cases with nearly normal health. In addition to deficient or absent pancreatic secretion, the complete syndrome includes chronic lung disease (responsible for most deaths), excessive salt loss in the sweat, and often cirrhosis of the liver. Survival of clearly affected children to adolescence was unlikely until recent years. Although probably recessive, innocuous conditions suggestive of the disease occur in some parents and siblings and the hereditary pattern cannot be defined with certainty.

Die genetischen Grundlagen der Sexualkonstitution des Menschen. (The genetic basis of sexual characteristics in man.) O. F. von Verschuer, *Zeitschrift für menschliche Vererbungs- und Konstitutionslehre* 33 (1956), pp. 316-329.

A review of abnormalities in human sexual differentiation reveals a variety of independent hereditary defects manifested in anatomical, hormonal or behavioral abnormalities. It is clear that numerous different genes, upon mutation, may result in sexually abnormal indi-

viduals. Although the abnormal types can be arranged on a quantitative scale from precocious maleness through bisexuality to femaleness, most instances seem to depend on single, major gene differences with characteristic effects. Human hermaphrodites are therefore unlike some animal intersexes, in which the defect results from an abnormal distribution of large numbers of genes, each with small effects (polygenes).

Essential familial hypercholesterolemia and xanthomatosis. Follow-up study of twelve Danish families. J. Piper and L. Orrild, *American Journal of Medicine 21* (1956), pp. 34-46.

Abnormally high levels of cholesterol in the blood may be inherited as a simple dominant trait. The investigators re-examined families studied in 1941 to 1943 and brought the total of affected persons in twelve families to 131. Like normal people, those with the defect showed an increasing concentration of cholesterol to about age 55, but the level is high from the start, and with advancing age nearly all develop fatty tumors. Fatty deposits in the blood vessels (antherosclerosis) result in a high incidence of coronary heart disease. With the exception of monstrous tumors found in one boy, all degrees of the condition were found in persons known to have only a single gene for hypercholesterolemia. The fatty tumors can therefore not be regarded as a recessive manifestation of the gene.

The chromosome number of man. J. H. Tjio and A. Levan, *Hereditas* 42 (1956) pp. 1-6.

Improved methods of studying the human chromosomes fail to give a high proportion of cells with the generally accepted number of 48. The number 46 appeared consistently in cells cultured from lungs of four human embryos. Before the count of human chromosomes is permanently revised, however, the new number must be confirmed for cells of the reproductive glands.

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POPULATION

La limitation des naissances en France. Institut national d'études démographiques. *Population* 11, 2 (April-June, 1956), 209-234.

In view of the importance of the question of birth limitation in France at the present time, the I.N.E.D. has felt a responsibility to present a summary of what is scientifically known about the matter, carefully pointing out areas of uncertainty. Among the various aspects of the problem, those having to do with morals and religion are explicitly excluded from this jointly authored discussion.

Following a section on terminology and a presentation of the basic law (of July 31, 1920) relative to birth limitation, the article considers the principal argument now advanced in favor of liberalizing the law insofar as it concerns the distribution of contraceptive information and materials, namely that a more ready availability of contraception would reduce the number of criminal abortions. The evidence at hand is found to furnish no foundation for this argument; nor does it permit any conclusion as to the effect of contraceptive practice on illegitimacy.

Since the disappearance of large families without an increase in the size of the smallest families would lead to a failure of the French population to replace itself (a net reproduction rate of 0.84 is envisaged if no family had more than three children), the maintenance of current levels of replacement in the face of actions tending to reduce family size would require the introduction of complementary policies favorable to families, notably the improvement of housing.

Although the introduction to the article disavows any intention to impose an opinion upon the reader, and the results of the study are found to be insufficiently precise to indicate a solution to the problem, the authors do permit themselves to advise a policy of proceeding slowly, seeking by approximations a way of reconciling the diverse objectives in view.

Social and psychological factors affecting fertility, XXXII: The number of children desired at the time of marriage. H. V. Muhsam and Clyde V. Kiser. *Milbank Memorial Fund Quarterly 34*, 3 (July, 1956), 287-312.

This thirty-second in the series of reports on the "Indianapolis Study" culls the data of that investigation for such light as they may shed on the relationship between the fertility desires of newly married couples and actual performance. As the authors take pains to point out, the results, though interesting, are generally inconclusive, not least because the information on family size desired at marriage was collected only after twelve to fifteen years of marriage had passed.

The most obvious features of the data are the popularity of the small-family ideal and the failure of the couples to achieve as a group even the average number of children they report having desired. The average number of children wanted at marriage was 2.36 for women and 2.18 for men. Actual family size aver-

aged 2.03. The chief topics explored in the analysis are the relationships between number of children wanted and the extent to which the couples became effective planners of family size, and between number of children wanted and actual number of children. It appears that close agreement between husband and wife as to desired family size was positively related to success in family planning, though the train of causal relationships is not clear.

While the authors do not believe that the results of the study deny the usefulness of desired family size as a datum for population forecasts, it is their opinion that "much more information on the relationship between the number of children wanted at the time of marriage and actual family size is needed before some information on the former can be used efficiently for forecasting the latter" (p. 311).

Field experience in family planning. Lakshman Prasad and Latika Ghosh. *Journal of Family Welfare* **2,** 3 (March, 1956), 98-100.

Based on interviews made by social workers for the Aligahr Maternity and Child Welfare Trust, this article summarizes some of the difficulties involved in introducing family planning in a middle-class Indian population. The chief objection to contraception is reported to be that it is "immoral and opposed to religious feelings and sentiments" (p. 98). Other factors are the general lack of education among women, ignorance of family planning measures, cost of contraceptive materials, lack of privacy, and fear that contraception may be harmful to health. In spite of these difficulties, "an overwhelming majority of women are eager to learn methods which will put a check to uncontrolled fertility" (p. 100). The authors believe, however, that free treatment of sterility is an essential part of a family planning program.

Readers will probably find it unfortunate that this report is so short as to include no information about the number of cases studied or the relative frequency with which various objections to family planning were encountered.

Attitudes of males toward family planning in a western Indian village. William A. Morrison. *Milbank Memorial Fund Quarterly* **34,** 3 (July, 1956), 262-286.

During 1954, 124 of the 573 married males aged 15-54 in a village forty-two miles from Bombay City were interviewed. This report, which is concerned with their answers to two questions, one about the desire for more offspring and the other about willingness to learn a method of contraception, consists largely of a discussion of the cross-tabulations of responses to these questions by various socio-cultural characteristics. It was found that a positive desire for more children tended to be associated with low values for the following variables: number of living children, number of living male children, duration of marriage, age, and education. Characteristics found to be significantly associated with willingness to learn contraception were: level of education, number of living children, number of living male children, and caste. A detailed discussion is given of cases that are exceptions to majority patterns.

In the author's opinion, two main socio-cultural life orientations for the Indian village can be distinguished, a traditional and a non-traditional. In both of these, a minimum of three living male children seems to be desired.

Publication of further materials from this research, including multivariate analysis of the data, is promised. Meanwhile the author views the demographic situation of India with hope in the light of the discovery that persons with attitudes and values favorable to family planning "do exist in reality in the villages of India in surprisingly large numbers" (p. 286).

A note on the relationship between illegitimacy and the birth rate. D. Ibberson. *Social and Economic Studies* **5,** 1 (March, 1956), 93-99.

This study inquires whether the general acceptance of legal marriage as a basis for the family would have a restraining influence on the birth rate in the British West Indies, where births to women who report themselves as single or members of common-law unions are now numerous. Data from the 1943 Census of Jamaica and the 1946 West Indies Census lead to the following conclusions (p. 99): (1) the majority of all children are born to women while unmarried. (2) Women recorded as married give birth to a higher average number of children than the unmarried. (3) The children of the married have better survival prospects. (4) Married women are less often childless than common-law women. (5) There is no evidence to show that promiscuity results in increased fertility, and some evidence exists to the contrary.

The author summarizes her findings by stating that it appears "that increased acceptance of marriage by women at young ages would, in present conditions, raise the birth rate" (p. 99).

The pattern of sex ratios in New Zealand. S. H. Franklin. *Economic Geography* **32,** 2 (April, 1956), 162-176.

This analysis of sex ratios observed in New Zealand in 1951 shows a higher degree of mas-

culinity in rural than in urban areas, the highest masculinity occurring in the least intensely farmed regions. The differences are directly attributed chiefly to the migration of females aged 15-25 and over 65, and indirectly to such factors as differential employment opportunities and social advantages. Among the Maoris, the same tendencies are found as among the whites, but the differences in sex ratios between the two groups, in both the rural and the urban setting, are cited by the author to demonstrate that the sex ratio may serve as an index of socio-economic conditions.

The article gives some attention to the nature and value of the sex ratio as a measure but does not deal with the interesting question of the effect of the sex ratio on nuptiality and fertility.

Mortalidad infantil española y crisis demográfica. Antonio Arbelo Curbelo. *Revista Internacional de Sociologia* **13,** 49-50 (January-June, 1955), 89-104.

The decline in the infant death rate of Spain from over 180 deaths per thousand live births in 1901 to fewer than 60 in 1954 is discussed in this paper as an illustration of the discontinuities that certain crises may bring into demographic development. During each of the three inter-crisis periods 1901-1917, 1921-1935, and 1942-1954, infant mortality declined in a fluctuating but essentialy linear fashion. The rate of decline was greater in each succeeding period. In the reviewer's opinion, however, the paper strains the information available in the data studied when it generalizes that after a demographic crisis the infant mortality rate assumes a movement that is "*always* more favorable" than that of the preceeding stage (p. 104, italics added).

The conclusion that for purposes of forecasting the long-run trend in the infant mortality rate, *e.g.,* the average rate of decline from 1901 to 1954, should only be studied in conjunction with the short-run trend of the most recent period is sound, though it may not be as clear as the author appears to believe that the short-run trend will always prove the better guide to future developments.

The immigration cycle in Palistine and Israel, 1919-1954. Edwin Samuel. *South African Journal of Economics* **24,** 1 (March, 1956), 29-36.

The demographic development of Palestine and Israel since the first world war, and more especially since the second, has been both unique and fascinating, characterized by the great role played by international migration, whether legal or legal. The article under review treats this migration in two ways, presenting both a newly computed table showing the extent of Jewish immigration and emigration, including estimated illegal immigration, since 1919 and a discussion of the forces that have influenced these movements at various times. It is concluded that "the centre of gravity of Israel's development lies essentially outside the country. . . . Immigration depends *primarily* on expulsive factors overseas" (p. 36). The immigration policies in Palestine have also played a rôle, however, as has the tendency of an immigration movement, once started, to snowball through publicity until inflation brings a crisis that discourages further inward movement. Of the massive immigration of 1948-1951 that doubled the Jewish population in three and one half years the author remarks that "it nearly wrecked the economy of the country, and one cannot recommend it as a method of development" (p. 31).

Current population trends in Iraq. Doris G. Adams. *Middle East Journal* **10,** 2 (Spring, 1956), 151-165.

On the basis of the first and only census of Iraq, taken in 1947, and certain other considerations, it appears that the population of the country in that year was about five million, of whom two-thirds lived outside of municipalities in villages and bedouin camps. The crude death rate is of the order of 30 per thousand and the crude birth rate perhaps 50 or 55 per thousand. In consequence, the crude rate of natural increase is estimated to fall between 2.0 percent and 2.5 per cent per annum, which implies a 1955 population near six million.

Other matters discussed in this article include age-sex structure, literacy, marital status, religion, occupation, housing, and internal migration. The inadequacies of the data are pointed out as a serious problem.

The rapid increase in the population that will result in a country of falling mortality where children still constitute a major source of prestige and social security for parents seems to the author a less formidable prospect for Iraq than for many underdeveloped countries because of three factors: significant unused resources, relatively low population relative to resources, and a large source of foreign exchange in the form of oil revenues.

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NEWS NOTES

The University of Wisconsin: A research program in medical genetics is to be instituted at the School of Medicine of the University of Wisconsin with partial support from a three-year grant from The Rockefeller Foundation. Dr. Newton Morton, formerly a member of the Atomic Bomb Casualty Commission, will direct the program.

The University of Indiana: A grant to support research in plant and animal genetics has been made to the University of Indiana by The Rockefeller Foundation. Professors H. J. Muller, T. M. Sonneborn, and R. E. Cleland will direct the program.

The grant will make it possible for Professor Muller to continue his research on the modifications of individual genes. Professor Sonnenborn's work may have an important bearing on research in the heredity of mammalian cancer. Professor Cleland has shown how a stable recombination of genes can be selected by environmental pressures to produce an entirely new species.

The work of the Indiana group is also being supported by the Atomic Energy Commission, the National Science Foundation, and the American Cancer Society.

The Johns Hopkins University: An outright Rockfeller Foundation grant for biological and biochemical research in genetics, cytology, and evolution has been received by John Hopkins University. Professor W. D. McElroy, director of the McCollum-Pratt Institute and newly appointed chairman of the Department of Biology will lead the research program.

The Johns Hopkins project emphasizes the broadest aspects of genetics and ranges from investigations into the minute chemical events in the process of mutation to studies on primate evolution and genetics of man.

Planned · Parenthood Federation of America: A new biological research committee for the improvement of birth control methods and infertility therapy has been established by the Planned Parenthood Federation of America.

Dr. Carl G. Hartman, former director of Ortho Research Foundation, heads the committee. Among its 13 members are Dr. Allan F. Guttmacher, vice president of the American Eugenics Society and Dr. Warren O. Nelson, Medical Director of The Population Council. This committee grew out of a conference on the physiology of reproduction sponsored jointly last spring by The Population Council and the Federation.

1957 Forum of the National Health Council: Better Mental Health is the subject of the 1957 Forum of the National Health Council, to be held in Cincinnati, Ohio, March 20-22, 1957. Dr. Francis J. Braceland, president of the American Psychiatric Association and psychiatrist-in-chief at the Institute of Living, Hartford, Conn., heads the program committee.

"The Forum will seek to outline what we now know about how to foster mental health and to encourage more effective use of that knowledge," says Dr. Braceland.

The Forum is one in an annual series conducted by the National Health Council in behalf of its more than fifty national organization members, of which the American Eugenics Society is one. Dr. Leona Baumgartner is president of the Council.

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INDEX

Eugenics Quarterly, Volume 3, 1956

Acta Geneticae Medicae et Gemellologiae, 61, 178
Adams, D. G., 242
Allen, G., 54, 55, 60, 61, 117-119, 178, 179, 183, 233, 234, 238, 239
Altshuler, K. Z., 234, 235
Alvarez, W., 143-147
American Eugenics Society, officers, 3; report of Committee on Genetics of Intelligence and Personality, 75-81; printed materials, 63, 127, 190; membership list, 243-252
American Journal of Human Genetics, 2, 60, 117-119
American Journal of Medicine, 239
American Journal of Sociology, 181
Annals of Human Genetics, 118, 178
Aschner, B., 16-21
"Associations Between Weight Discrimination and Hand Prints," 213-219

Back, K. W., 120
Berry, H. K., 119
Beukering, J. A., 178
"Biology, Rationality, and Fertility," 157-160
Birth control, and Catholic position, 9-15, 82-87; and research, 139, 142; in Great Britain, 148-151. *See also* fertility.
Blacker, C. P., 119
Blake, J., 181, 182
Book, J. A., 117, 178
Book reviews, "Heredity in Medicine," 52; "Progenesis," 52, 53, "Counseling in Medical Genetics," 53, 54; "Investigations on Genetic Aspects of Carcinoma of the Stomach, and Breast," 54, 55, "Search for Purpose," 54-57; "Family and Fertility in Puerto Rica," 57-59; "Medical Research: A Mid-century Survey," 109-111; "Evolution, Genetics, and Man," 112, 113; "Genetics and Metabolism," 113; "Uncommon People," 113-116; "Human Heredity," 169-173; "Man's Nature and Nature's Man," 173, 174; "Population," 174, 175; "Exploring the Musical Mind," 175, 176; "Trends and Differentials in Mortality," 228-230; "World Population and Resources," 230, 231; "Life Tables from Limited Data," 232-233; "Elements of Genetics," 234, 235; "Sociology and the Field of Mental Health," 234, 235; "Races and People, 235; "Genetics in the Atomic Age," 235, 236; "Education for Marriage," 236, 237
British Medical Journal, 119
Buckwalter, J. A., 178

Campbell, A., 232, 233
Cheeseman, E. A., 178
Christiensen, H. T., 121
Clark, C., 121
Clausen, J. A., 173, 174
Cohen, B. H., 178
Contemporary Psychology, 125
"Control of Conception by Physiologic Methods," 139-142
Cook, R. C., 4-8
Cordon, W. M., 121
Count, G., 236, 237
Crow, J. F., 201-208
Curbelo, C., 241

D'Alonzo, C. A., 60
Davis, K., 181, 182
Dexter, L. A., 88-93
Dinkel, R. M., 22-31
Disease, treatment in hereditary, 16-21; hereditary susceptibility to rheumatic fever, 38-44; and heredity counseling, 45-51; genetic aspects of deafness, 69-74; relatives of psychotics, epileptics and alcoholics, 143-147; breast cancer, 183, and blood groups, 197, 198. *See also* heredity counseling and periodical abstracts.
Dunn, L. C., 33

Economic Development and Cultural Change, 181
Economic Geography, 240
Economic Record, 121
Edington, G. M., 119
Editorial Comment, 3, 67, 68
Ehrmann, W., 219-227
"Estimation of Spontaneous and Radiation-induced Mutations in Man," 201-208
Eugenic Hypothesis, 4-8, 164-168
Eugenics Quarterly, Index, 253-255
Eugenics Review, 60, 119

Fertility, its control and Catholic statements, 9-15, 83-87; new Milbank study, 22-24; Puerto Rican project, 25; Survey Research Center Study, 27, Swedish study, 27, 28, and census monographs, 29-31; and social characteristics, 100-103; methodology of Indianapolis study, 152-156; fertility transition, 157-158; needed research, 159, 160
"Fertility Control in the Light of Some Recent Catholic Statements," 9-15, 82-87
"Fertility in Mid-century America," 22-31
First International Congress of Human Genetics, program, 123, 184-188; perspectives, 195-200
Franklin, S. H., 240
Fraser, F. C., 45-51
Freedman, R., 181
Friedman, G. A., 117
Fuller, J. L., 209-212

Gartler, S., 113, 119
Genetics, improvement of human genotypes, 32-37; medical application of theory, 76-78; research on intelligence and personality, 75-81; specification of environments, 88-93; hereditary abilities, 94-99; incestuous matings, 104, 105; and behavior, 209-212. *See also* heredity, counseling, periodical abstracts, radiation.
"Genetic and Eugenic Aspects of Early Total Deafness," 69-74
"Genetic-Hygienic Impairment through Incestuous Matings," 104, 105
"Genetics in the Atomic Age, 131-138
Ghosh, L., 240
Gibbons, W. J., 9-15, 82-87
Gurard, A., 180
Glass, B., 117, 178
Good, D., 174, 175
Goodman, H., 175, 176

Haberlandt, W., 52, 53
Haldane, J. B. S., 238
Hammons, H. G., 195-200

Hanlon, D. G., 238
Hankins, F., 55-57, 164-168
Hauser, P. H., 230, 231
Henry, L., 180
Hereditas, 239
Heredity, *see* heredity counseling and genetics
"Hereditary Abilities Studies," 94-99
"Hereditary Susceptibility in Rheumatic Fever," 38-44
Heredity counseling, the darker side, 45-51; role of the doctor, 106-108; obstetrician and congenital malformations in brothers and sisters, 161-163
"Heredity and Environment Reexplored," 88-93
Hewitt, D., 118
Hill, R., 120
Human Biology, 178

Ibberson, D., 240
"Illegitimacy in Florida," 219-227
Index, *Eugenics Quarterly*, Vol. 3, 1956, 253-255
Indian Economic Journal, 179
Isselbacher, K. J., 238

Jarvik, L. F., 53, 54
Johns Hopkins Magazine, 117
Journal de genétique humaine, 118
Journal of American Institute of Planners, 179
Journal of American Medical Association, 60, 61, 238
Journal of Family Welfare, 240

Kallmann, F. J., 52, 53, 69-74, 183
Kerckhoff, A. C., 180
Kirsh, I. E., 61
Kiser, C. V., 57-59, 62, 152, 156, 239
Klapprodt, C., 62
Klein, D., 118
Kloepfer, H. W., 117
Kostman, R., 178
Krooth, R. S., 118
Kurland, L. T., 118

Larson, C. A., 104, 105
Lauriat, P., 62
Lehmann, H., 119
Leslie, G. R., 121
Letters, 4-8
Levan, A., 238
Lorimer, F., 75-81

MacMahon, B., 61
Mair, G. F., 119-122, 179-182, 239-241
Mawe, C. E., 117
Mayer, A., 62
McKeown, T., 61
"Medical Complaints of Relatives of Psychotics, Alcoholics, and Epileptics," 143-147
Medical Times, 117
"Methodological Lessons of the Indianapolis Study," 152-156
Middle East Journal, 242
Milbank Memorial Quarterly, 62, 240, 241
Morrison, W. A., 240
Morton, N. E., 60
Muhsam, H. V., 239
Mulder, D. W., 118
Murphy, D. P., 161-163

Neel, J. V., 60
Nelson, W., 139-142
Neurology, 118
News Notes, 123-125, 183
News of Population and Birth Control, 125

Orrild, L., 239
Ounsted, C., 60

Pacific Affairs, 120
"Path Between Genes and Behavioral Characters," 209-212
Pearman, G. T., 121
Periodical abstracts, *Genetics:* childhood epilepsy, 60; detection of linkage, 60; polyposis of the colon, 60; hypertension in industrial workers, 60; infantile hypertrophic pyloric stenosis, 61; pattern score of fingerprints, 61; radiation danger in diagnostic radiology, 61; gifted Germans of Jewish descent and their relatives, 61, 119; cousin marriages, 117; spherophakia-brachy-morphia syndrome, 117; genetics in service of man, 117; blood testing, 117; single-sex sibships, 118; amyotrophic lateral sclerosis, 118; fertilities of affected individuals and unaffected sibs in estimation of fitness, 118; amaurotic idiocy, 118; urinary excretion in twins and chromotographic studies, 119; sickle cell gene in Africa, 119; biochemical genetics in medicine, 178; natural selection and ABO blood group, 178; sex ratio and ABO blood groups, 178; mongolism in twins, 178; deaf mutism, 178; legendary Thai tribe, 179; congenital galactosemia, 239; hereditary leptocytosis, 239; measurement of natural selection, 239; fibrocystic disease of the pancreas, 239; sexual characteristics in man, 239; hypercholesterolemia, 240; chromosome number of man, 240. *Population*: age at marriage and education U.S. 62; fertility by socio-economic status, 62; fertility in Detroit, 62; rhythm method in India, 119, 120; population in Japan, 120; fertility in Puerto Rico, 120, 121; child spacing, 121; population increase, 121, 122; population growth in India, 179; metropolitan planning, 179; residential propinquity in mate selection, 180; French attitudes on family size, 180; estimating desired family size, 180, 181; growth of American families, 181; fertility and social structure, 181, 182; birth control in France, 240; social and psychological factors affecting fertility, 240; family planning, 241; illegitimacy, 241; sex ratio in New Zealand, 241; infant death rate in Spain, 242; immigration in Palestine and Israel, 242; population trends in Iraq, 242
"Perspectives: First International Congress of Human Genetics," 195-200
Piper, J., 239
Population, Population Reference Bureau, 123; Population Council, 123, 124, Conservation Foundation, 124, and genetics, 136; and illegitimate births, 219-227. *See also* birth control, fertility, and periodical abstracts.
Population, 180, 239
"Population Planning in Great Britain," 148-151
Population Studies, 62, 180
Post, R. H., 234, 235
Potter, R. G., 180
Prasad, L., 240
"Prospects for Genetic Improvement," 32-37
Pyke, M., 148-151

Queens Quarterly, 121
Radiation, and hazards to genotype, 35, 131-138; and atomic warfare, 138; and Nagasaki, Hiro-

shima study, 131, 132; and mutations, 196, 197, 201-208
Rainer, J., 109-111
Reed, S., 106-108
Reed, T. E., 60
"Research on Intelligence and Personality," 75-81
Revista Internacional de Sociologia, 241
Rife, D., 213-218
Rosenthal, J. W., 117

Samuel, E., 241
Sank, D., 69-74
Schulz, B., 61, 119
Science, 178, 179, 238
Shapiro, S., 228-230
Sinha, J. N., 179
"Social Characteristics and Fertility," 100-103
Social Forces, 121, 180
Social and Economic Studies, 240
Social Problems, 120
Sociometry, 125
Solomon, E. S., 100-103
South African Journal of Economics, 241
Spielman, R., 179
Steinberg, A. G., 169-170
Stern, C., 131-138
Stevenson, A. C., 178
Stycos, J. M., 120

Taueber, I., 120
Thorner, R. M., 219-227
Tietze, C., 62
Tjio, J. H., 238
"Treatment in Hereditary Diseases," 16-21
Twin Studies, 91, 92, 94-99

Van Bogaert, L., 118
Vandenberg, S. S., 94-99
Van Nort, L., 157-160
Von Verschuer, O. F., 173, 238
Vervoorin, J. D., 178
Visher, S. S., 113-116
Vogt, W., 176, 177

Weaver, R. W., 179
Wendt, G. G., 61
Whelpton, P. K., 181
Williams, E. H. Jr., 219-227
Wilson, M. G., 38-44

Zeitschrift für menschliche Vererbungs und Konstitutionslehre, 61, 238

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